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NATIONAL GEOGRAPHIC

JUNE 2007 • VOL. 211 • NO. 6

Carl Linnaeus was fascinated by plant names. He would have known the flower at right, blue sage, as *Eranthemum*. Story on page 72.

HELENE SCHMITZ

Features

COVER Meltwater drains from the Greenland ice sheet.
PHOTO BY JAMES BALOG

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WHEN MILLIONS OF KIDS ARE WAITING FOR THE LATEST GAME CONSOLE, AUSTIN CANNON NEVER HITS THE PAUSE BUTTON.

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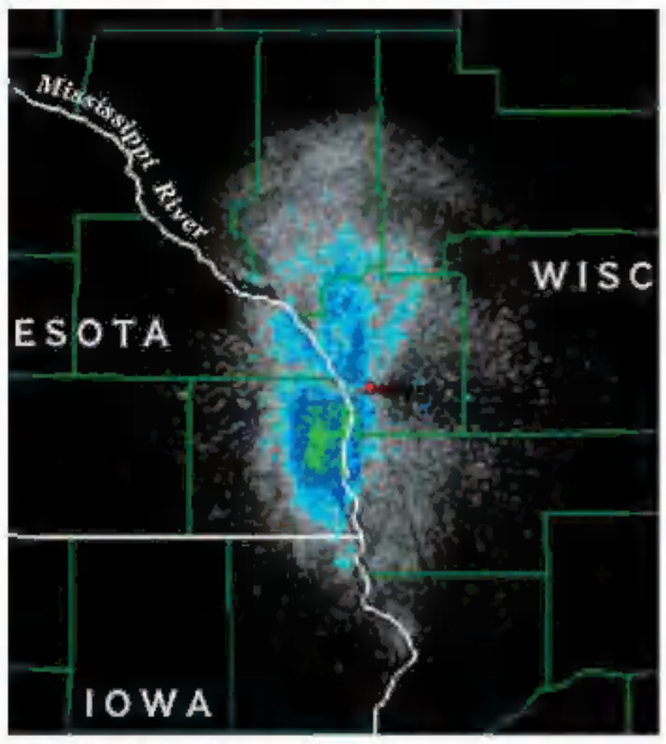

Mayfly Swarm


Endangered Ferrets


Saving Seeds

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Eyeing Eagles
Get a bird's-eye view of a bald eagle aerie on the craggy coast of Maine in our latest WildCam, where you'll watch a mated pair raise their young. The action is at ngm.com/eaglecam.

Pick a Flower
Decorate your desktop with photographs of blooms classified by botanist Carl Linnaeus.

Bat Signals
Listen to the high-pitched sounds that bats emit to detect objects. The echolocation calls have been digitally altered so human ears can hear them.

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PHOTOS (LEFT TO RIGHT): NOAA NATIONAL WEATHER SERVICE; JOEL SARTORE; VIKTOR SYKORA

People with COPD breathe better with SPIRIVA.

If you have a history of smoking and breathing problems, it could be COPD (chronic obstructive pulmonary disease). COPD includes chronic bronchitis and emphysema.

Ask your doctor about SPIRIVA, because it:

- Is the only once-daily, inhaled maintenance prescription treatment for COPD
- Helps you breathe better for a full 24 hours by keeping airways open
- Is not a steroid

Please see brief summary of full Prescribing Information on reverse.

SPIRIVA does not replace fast-acting inhalers for sudden symptoms. Do not swallow the SPIRIVA capsule. The most common side effect of SPIRIVA is dry mouth. Others include constipation and problems passing urine. Tell your doctor about your medicines, including eye drops, and illnesses like glaucoma and urinary or prostate problems. These may worsen with SPIRIVA. If you have vision changes, eye pain, your breathing suddenly worsens, you get hives, or your throat or tongue swells, stop taking SPIRIVA and contact your doctor. For more information, call 1.877.SPIRIVA or visit spiriva.com

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(tiotropium bromide inhalation powder)

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FOR ORAL INHALATION ONLY

Brief Summary of Prescribing Information

INDICATIONS AND USAGE

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is indicated for the long-term, once-daily, maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema.

CONTRAINDICATIONS

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is contraindicated in patients with a history of hypersensitivity to atropine or its derivatives, including ipratropium, or to any component of this product.

WARNINGS

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is intended as a once-daily maintenance treatment for COPD and is not indicated for the initial treatment of acute episodes of bronchospasm, i.e., rescue therapy. Immediate hypersensitivity reactions, including angioedema, may occur after administration of SPIRIVA. If such a reaction occurs, therapy with SPIRIVA should be stopped at once and alternative treatments should be considered. Inhaled medicines, including SPIRIVA, may cause paradoxical bronchospasm. If this occurs, treatment with SPIRIVA should be stopped and other treatments considered.

PRECAUTIONS

General

As an anticholinergic drug, SPIRIVA (tiotropium bromide inhalation powder) may potentially worsen symptoms and signs associated with narrow-angle glaucoma, prostatic hyperplasia or bladder-neck obstruction and should be used with caution in patients with any of these conditions. As a predominantly renally excreted drug, patients with moderate to severe renal impairment (creatinin clearance of ≤50 mL/min) treated with SPIRIVA should be monitored closely (see **CLINICAL PHARMACOLOGY, Pharmacokinetics, Special Populations**, *Renally-Impaired Patients*).

Information for Patients

It is important for patients to understand how to correctly administer SPIRIVA capsules using the HandiHaler inhalation device (**see Patient's Instructions for Use**). SPIRIVA capsules should only be administered via the HandiHaler device and the HandiHaler device should not be used for administering other medications. Capsules should always be stored in sealed blisters. Remove only one capsule immediately before use, or its effectiveness may be reduced. Additional capsules that are exposed to air (i.e., not intended for immediate use) should be discarded. Eye pain or discomfort, blurred vision, visual halos or colored images in association with red eyes from conjunctival congestion and corneal edema may be signs of acute narrow-angle glaucoma. Should any of these signs and symptoms develop, consult a physician immediately. Miotic eye drops alone are not considered to be effective treatment. Care must be taken not to allow the powder to enter into the eyes as this may cause blurring of vision and pupil dilation.

SPIRIVA HandiHaler is a once-daily maintenance bronchodilator and should not be used for immediate relief of breathing problems, i.e., as a rescue medication.

Drug Interactions

SPIRIVA has been used concomitantly with other drugs commonly used in COPD without increases in adverse drug reactions. These include sympathomimetic bronchodilators, methylxanthines, and oral and inhaled steroids. However, the co-administration of SPIRIVA with other anticholinergic-containing drugs (e.g., ipratropium) has not been studied and is therefore not recommended.

Drug/Laboratory Test Interactions

None known.

Carcinogenesis, Mutagenesis, Impairment of Fertility

No evidence of tumorigenicity was observed in a 104-week inhalation study in rats at tiotropium doses up to 0.059 mg/kg/day, in an 83-week inhalation study in female mice at doses up to 0.145 mg/kg/day, and in a 101-week inhalation study in male mice at doses up to 0.002 mg/kg/day. These doses correspond to 25, 35, and 0.5 times the Recommended Human Daily Dose (RHDD) on a mg/m^2 basis, respectively. These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies. Tiotropium bromide demonstrated no evidence of mutagenicity or clastogenicity in the following assays: the bacterial gene mutation assay, the V79 Chinese hamster cell mutagenesis assay, the chromosomal aberration assays in human lymphocytes *in vitro* and mouse micronucleus formation *in vivo*, and the unscheduled DNA synthesis in primary rat hepatocytes *in vitro* assay. In rats, decreases in the number of corpora lutea and the percentage of implants were noted at inhalation tiotropium doses of 0.078 mg/kg/day or greater (approximately 35 times the RHDD on a mg/m^2 basis). No such effects were observed at 0.009 mg/kg/day (approximately 4 times than the RHDD on a mg/m^2 basis). The fertility index, however, was not affected at inhalation doses up to 1.689 mg/kg/day (approximately 760 times the RHDD on a mg/m^2 basis). These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies.

Pregnancy

Pregnancy Category C

No evidence of structural alterations was observed in rats and rabbits at inhalation tiotropium doses of up to 1.471 and 0.007 mg/kg/day, respectively. These doses correspond to approximately 660 and 6 times the recommended human daily dose (RHDD) on a mg/m^2 basis. However, in rats, fetal resorption, litter loss, decreases in the number of live pups at birth and the mean pup weights, and a delay in pup sexual maturation were observed at inhalation tiotropium doses of ≥0.078 mg/kg (approximately 35 times the RHDD on a mg/m^2 basis). In rabbits, an increase in post-implantation loss was observed at an inhalation dose of 0.4 mg/kg/day (approximately 360 times the RHDD on a mg/m^2 basis). Such effects were not observed at inhalation doses of 0.009 and up to 0.088 mg/kg/day in rats and rabbits, respectively. These doses correspond to approximately 4 and 80 times the RHDD on a mg/m^2 basis, respectively. These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies. There are no adequate and well-controlled studies in pregnant women. SPIRIVA should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Use in Labor and Delivery

The safety and effectiveness of SPIRIVA has not been studied during labor and delivery.

Nursing Mothers

Clinical data from nursing women exposed to tiotropium are not available. Based on lactating rodent studies, tiotropium is excreted into breast milk. It is not known whether tiotropium is excreted in human milk, but because many drugs are excreted in human milk and given these findings in rats, caution should be exercised if SPIRIVA is administered to a nursing woman.

Pediatric Use

SPIRIVA HandiHaler is approved for use in the maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease, including chronic bronchitis and emphysema. This disease does not normally occur in children. The safety and effectiveness of SPIRIVA in pediatric patients have not been established.

Geriatric Use

Of the total number of patients who received SPIRIVA in the 1-year clinical trials, 426 were <65 years, 375 were 65–74 years and 105 were ≥75 years of age. Within each age subgroup, there were no differences between the proportion of patients with adverse events in the SPIRIVA and the comparator groups for most events. Dry mouth increased with age in the SPIRIVA group (differences from placebo were 9.0%, 17.1%, and 16.2% in the aforementioned age subgroups). A higher frequency of constipation and urinary tract infections with increasing age was observed in the SPIRIVA group in the placebo-controlled studies. The differences from placebo for constipation were 0%, 1.8%, and 7.8% for each of the age groups. The differences from placebo for urinary tract infections were −0.6%, 4.6% and 4.5%. No overall differences in effectiveness were observed among these groups. Based on available data, no adjustment of SPIRIVA dosage in geriatric patients is warranted.

ADVERSE REACTIONS

Of the 2,663 patients in the four 1-year and two 6-month controlled clinical trials, 1,308 were treated with SPIRIVA (tiotropium bromide inhalation powder) at the recommended dose of 18 mcg once a day. Patients with narrow angle glaucoma, or symptomatic prostatic hypertrophy or bladder outlet obstruction were excluded from these trials. The most commonly reported adverse drug reaction was dry mouth. Dry mouth was usually mild and often resolved during continued treatment. Other reactions reported in individual patients and consistent with possible anticholinergic effects included constipation, increased heart rate, blurred vision, glaucoma, urinary difficulty, and urinary retention. Four multicenter, 1-year, controlled studies evaluated SPIRIVA in patients with COPD. Table 1 shows all adverse events that occurred with a frequency of ≥3% in the SPIRIVA group in the 1-year placebo-controlled trials where the rates in the SPIRIVA group exceeded placebo by ≥1%. The frequency of corresponding events in the ipratropium-controlled trials is included for comparison.

Table 1: Adverse Experience Incidence (% Patients) in One-Year-COPD Clinical Trials

Body System (Event)	Placebo-Controlled Trials		Ipratropium-Controlled Trials	
	SPIRIVA [n = 550]	Placebo [n = 371]	SPIRIVA [n = 356]	Ipratropium [n = 179]
Body as a Whole				
Accidents	13	11	5	8
Chest Pain (non-specific)	7	5	5	2
Edema, Dependent	5	4	3	5
Gastrointestinal System Disorders				
Abdominal Pain	5	3	6	6
Constipation	4	2	1	1
Dry Mouth	16	3	12	6
Dyspepsia	6	5	1	1
Vomiting	4	2	1	2
Musculoskeletal System				
Myalgia	4	3	4	3
Resistance Mechanism Disorders				
Infection	4	3	1	3
Moniliasis	4	2	3	2
Respiratory System (upper)				
Epistaxis	4	2	1	1
Pharyngitis	9	7	7	3
Rhinitis	6	5	3	2
Sinusitis	11	9	3	2
Upper Respiratory Tract Infection	41	37	43	35
Skin and Appendage Disorders				
Rash	4	2	2	2
Urinary System				
Urinary Tract Infection	7	5	4	2

Arthritis, coughing, and influenza-like symptoms occurred at a rate of ≥3% in the SPIRIVA treatment group, but were <1% in excess of the placebo group. Other events that occurred in the SPIRIVA group at a frequency of 1–3% in the placebo-controlled trials where the rates exceeded that in the placebo group include: *Body as a Whole:* allergic reaction, leg pain; *Central and Peripheral Nervous System:* dysphonia, paresthesia; *Gastrointestinal System Disorders:* gastrointestinal disorder not otherwise specified (NOS), gastroesophageal reflux, stomatitis (including ulcerative stomatitis); *Metabolic and Nutritional Disorders:* hypercholesterolemia, hyperglycemia; *Musculoskeletal System Disorders:* skeletal pain; *Cardiac Events:* angina pectoris (including aggravated angina pectoris); *Psychiatric Disorder:* depression; *Infections:* herpes zoster; *Respiratory System Disorder (Upper):* laryngitis; *Vision Disorder:* cataract In addition, among the adverse events observed in the clinical trials with an incidence of <1% were atrial fibrillation, supraventricular tachycardia, angioedema, and urinary retention. In the 1-year trials, the incidence of dry mouth, constipation, and urinary tract infection increased with age (see **PRECAUTIONS, Geriatric Use**). Two multicenter, 6-month, controlled studies evaluated SPIRIVA in patients with COPD. The adverse events and the incidence rates were similar to those seen in the 1-year controlled trials. The following adverse reactions have been identified during worldwide post-approval use of SPIRIVA: dizziness, dysphagia, epistaxis, hoarseness, intestinal obstruction including ileus paralytic, intraocular pressure increased, oral candidiasis, palpitations, pruritus, tachycardia, throat irritation, and urticaria.

DOSAGE AND ADMINISTRATION

The recommended dosage of SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is the inhalation of the contents of one SPIRIVA capsule, once-daily, with the HandiHaler inhalation device (see **Patient's Instructions for Use**). No dosage adjustment is required for geriatric, hepatically-impaired, or renally-impaired patients. However, patients with moderate to severe renal impairment given SPIRIVA should be monitored closely (see **CLINICAL PHARMACOLOGY, Pharmacokinetics, Special Populations** and **PRECAUTIONS**). SPIRIVA capsules are for inhalation only and must not be swallowed.

HOW SUPPLIED

The following packages are available:

carton containing 5 SPIRIVA capsules (1 unit-dose blister card) and 1 HandiHaler inhalation device (NDC 0597-0075-75)

carton containing 30 SPIRIVA capsules (3 unit-dose blister cards) and 1 HandiHaler inhalation device (NDC 0597 0075-41)

carton containing 90 SPIRIVA capsules (9 unit-dose blister cards) and 1 HandiHaler inhalation device (NDC 0597 0075-47)

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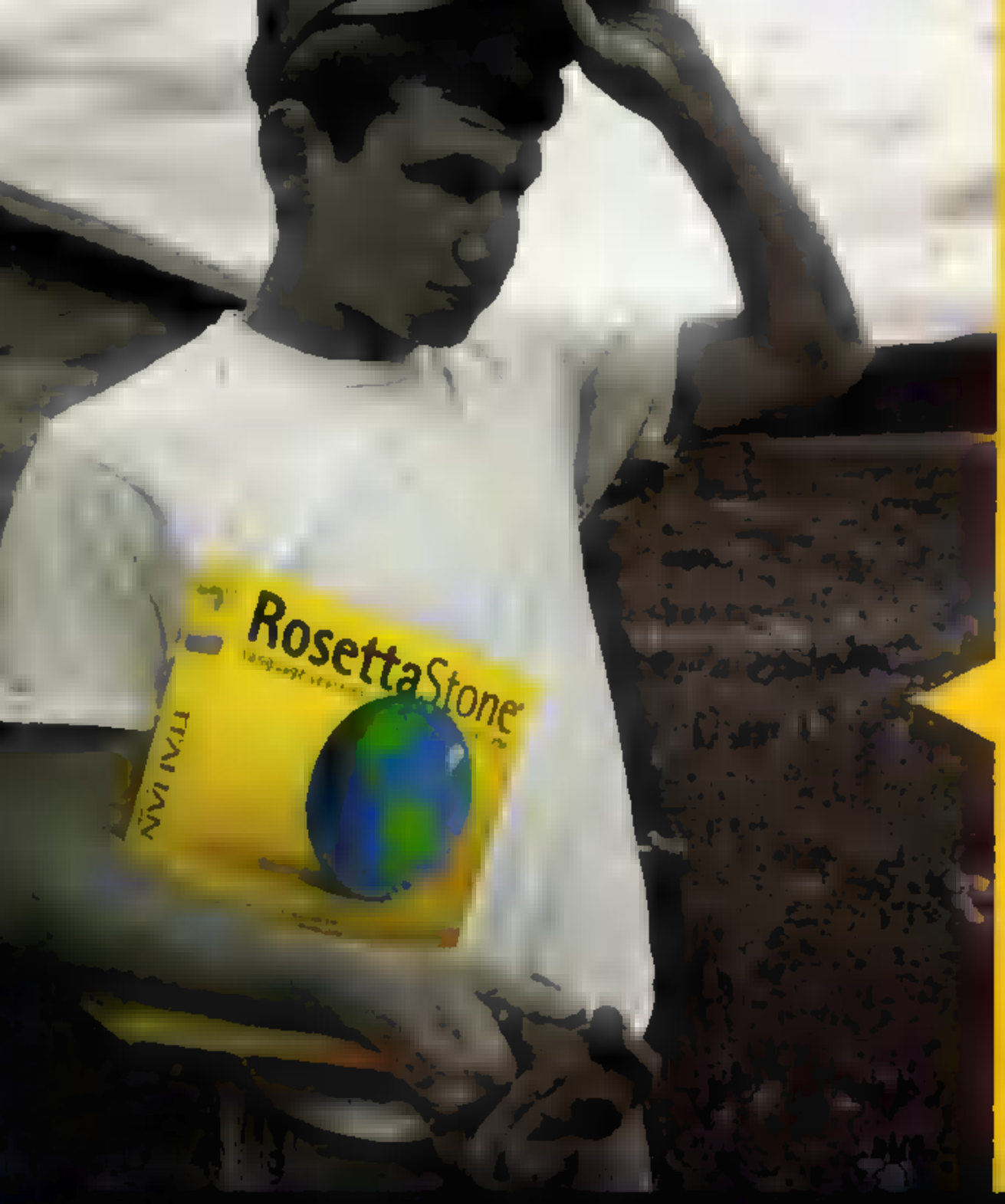

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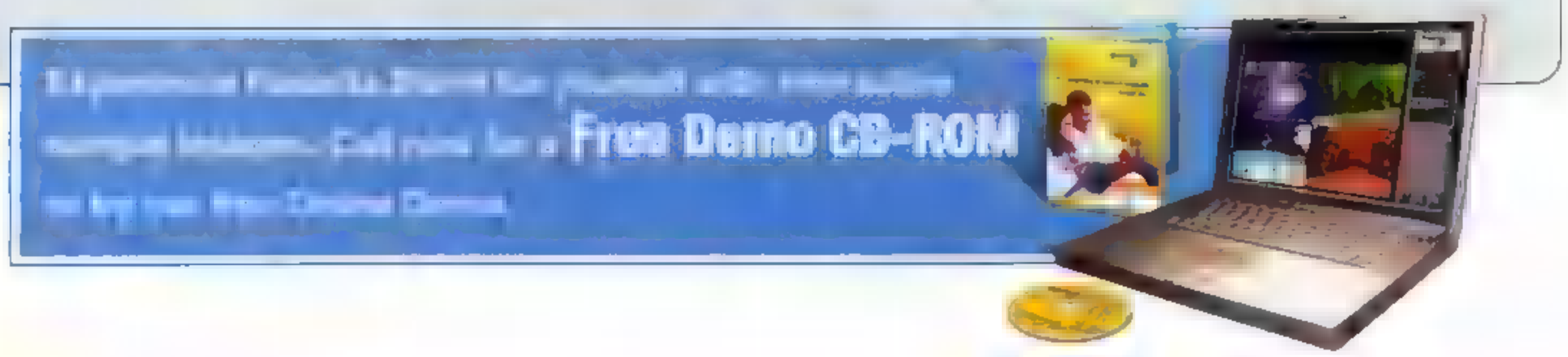

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EDITOR'S NOTE

At first, Paul Nicklen couldn't see what the Inuit were staring at, but that happens when you're five years old. Finally, he saw a silhouette a half mile away, floating effortlessly across the ice in search of food. "This was my first polar bear sighting. I wasn't scared. I was in awe," recalls Paul, the photographer for this month's story "Life at the Edge."

Thirty-six years ago, Paul's family moved to Baffin Island, Canada. He was only three. "There was no television, radio, movies, and certainly no Internet. Nature was our entertainment. I was taught to see the Arctic through the eyes of the Inuit."

The Inuit regaled Paul with harrowing stories laced with warnings about the unforgiving Arctic environment. He loved most the

A polar bear stalks the sea ice near Canada's Ellesmere Island.

tale of Qalupalik, a frightening sea monster. "They'd say if you got too close to the ice edge, she'd take you off the ice, put you in her parka hood, drown you, and eat you. The hunters would bring back seal flippers and tell us they had cut off Qalupalik's hand. I believed in her until I was 12 or 13—and stayed away from the ice edge."

But now Paul is drawn to the ice edge. For more than ten years he has photographed the life it nourishes, and each year he has felt an increased sense of urgency. Rising temperatures are shrinking the sea ice. The ice edge the Inuit threatened young Paul with is itself threatened, and perhaps no creature stands to suffer more than the polar bear. U.S. Fish and Wildlife officials worry that polar bears could become extinct by the end of this century.

Unlike Paul, I had to wait until I was 31 years old to see a polar bear, but just like Paul, I wasn't scared—I was in awe.

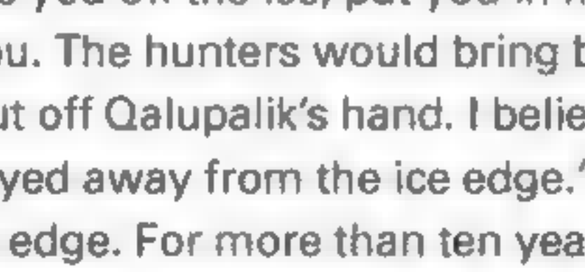

PHOTO: PAUL NICKLEN, NATIONAL GEOGRAPHIC IMAGE COLLECTION

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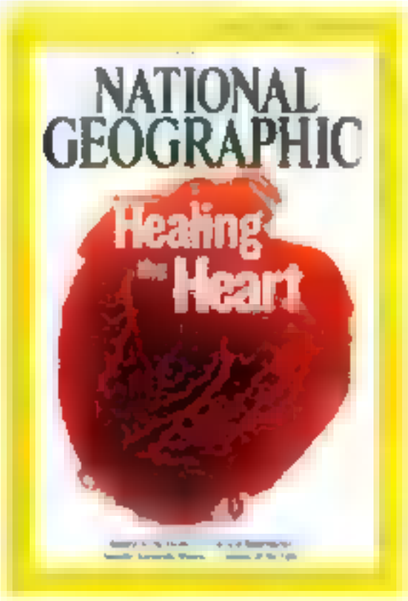
LETTERS



February 2007 *Readers Greg and Beth Lynch of Tucson, Arizona, took issue with a question posed to Francis Collins in Voices: Does religion require suffering? They wrote, "The real question is, Does suffering need religion? Suffering needs altruistic love in action by those who are made aware of the suffering. That is the very essence of our purpose in life."*

Comment on June stories at **ngm.com**.

Mending Broken Hearts

Since receiving the miracle of a heart transplant in 1990, I have devoted my time to advocating organ- and tissue-donor awareness. The shortage of donors for transplantation has not improved since 1990. There are over 90,000 people waiting for a transplant, and unfortunately one-third will die. Medical advancements have given me a second chance, to watch my daughter get married, find the love of a woman, enjoy spoiling nine grandchildren, hit a golf ball, and enjoy the pleasures of life. The future is going to be exciting, and my legacy will be that I was part of the cure for heart disease.

BRIAN A. HARTFORD
Milford, Delaware

While not for the faint of heart, the pictures on pages 60-63 are well worth looking at more than once. If these aren't enough of a wake-up call for people with unhealthy lifestyles, I don't know what is. I hope lessons are learned from this article, and people start making positive changes. At least control the 50 percent you can—enough cheeseburgers already!

ANTHONY COZZI
Toronto, Ontario

I was quite surprised by the medical-pharmaceutical bias in your article. Proper nutrition, a vigorous exercise program, and a reduced-stress lifestyle were all but discounted in favor of surgical procedures or prescription medicines. Simply stated, there is really no economic

incentive for the teaching of a healthy lifestyle to our nation's children. Many large hospitals feature ■ fast-food restaurant within their facilities. It would seem that it pays best for the entire health industry when we are sick. With the banning of trans fats and public smoking, there appears to be a changing of public values along with a recognition of our own role in the prevention of illness. Until people realize that it is their responsibility to be healthy, not their doctor's, illnesses like heart disease will remain a major problem.

BILL REUTER
Hutchinson Island, Florida

It is fascinating to look at the pictures of transplanting an artificial heart. What's more amazing is the dedication of the surgeon and the rest of the medical community in helping people stay alive. I salute them; they are the true heroes.

JOSEPHINE ORTEGA
Cherry Hill, New Jersey

The annual one million angioplasty procedures, 400,000 coronary artery bypass grafts, 2,000 heart transplants, and a soon-to-be flood of artificial hearts are very expensive and greatly tax this country. Such economic concerns in our aging population may force a system of national health care with fair and easy free access for our entire population.

JAMES H. NELSON, M.D.
Puyallup, Washington

Desolate Majesty

I take exception to the word "desolate" in the article about the Big Bend region of the Chihuahuan Desert. Many species of animals inhabit the area. The plants that survive in that harsh environment are a wonder. In my visit last June I found the area one of the more "alive" places I have been.

PAUL WILDING
Dallas, Texas

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LETTERS

This is a place so formidable the ordinary tourist would rarely want to venture into it. In the mid-nineties my husband and I ventured down through the wide open spaces to visit Big Bend National Park. Our campground view, through ■ canyon that seemed to go on forever, took our breath away. Your article brought back so vividly the stark beauty of the area. I hope others will be encouraged to appreciate it.

BETTY CATALANELLO
Durham, California

Curse of the Black Gold

The sad situation of the Nigerian people is born of the morally bankrupt greed of the oil-hungry West. We veil the sickening truth with platitudes about the market and national sovereignty. The reason the governments of the West work to maintain stability throughout these former colonial lands is so that the extractive activities upon which we feed can continue efficiently. Civilized people everywhere should be ashamed of the complicity of their leaders. The contrast in the photo of the sterile efficiency of the Total operation with the life of the average Nigerian surviving in a shantytown strikes a chord. Unfortunately, too many fail to hear the song of sadness and act.

TOM SCHMITZ
Dulles, Virginia

Nationally, Nigerian income from oil represents less than a dollar a person a day. It is clear that oil alone cannot rescue Nigeria from poverty. Major investment is urgently required in the delta. In 2006, the government allocated 3.5 billion dollars to the four major oil-producing states in Nigeria. The remaining 32 states shared 6.5 billion dollars. The Niger Delta remains ■ challenging place to operate, but as ■ business, Shell Nigeria is committed to contributing to regional development. We spend an average of 115 million dollars in Nigeria on sustainable-development programs annually —75 million dollars of which goes directly to the Niger Delta Development Corporation.

BASIL OMIYI
County Chair, Shell Nigeria
Lagos, Nigeria

LETTERS

Voices: Francis Collins

I'm not a scientist or theologian by trade, but, as a Christian who is also a science enthusiast, I desire to read honest debate on specific issues. Unfortunately, both sides seem so dogmatic that no genuine discussion is possible. I do not understand why people of science feel a need to disprove God. Nor do I understand why believers would choose to define science as an enemy of faith. My study of science continues to grow and support my belief in a creator.

JENNIFER EATON
Gorham, Maine

You just cannot make any logic or sense out of religious ideas: I was once told that to believe, you had to have faith, and to have faith, you had to believe! Religion should be consigned to the dustbin of medieval superstitions where it belongs.

JOHN WALTON
Buckingham, England

A publication that is devoted to the scientific method should not devote space to superstition. While the interview included questions about miracles, free will, evil, and "things I cannot know," there was not a single question about the existence of any scientific evidence that supports a supernatural God. I am loath to see GEOGRAPHIC get mired in the endless religious debates raging around the world. As a member and a reader, I would prefer that you simply stay away from the subject altogether.

NORMAN S. THAYER
Albuquerque, New Mexico

As ■ student anthropologist and also ■ devout Catholic, I often witness firsthand the collision between science and religion. I applaud Collins for bridging the gap. I can see God working every time I discuss evolution and human origins; it is not an either-or proposition. The incredible journey that our species has undergone, from our humble origins as one species among many competitors to the present day, leaves me continually in awe. In short, the reason I can believe in miracles is

because we as humans are living one every day.

KATHERINE D. SHERMAN
Louisville, Kentucky

Collins assaults reason when, in an attempt to cast doubt on the genetic basis for altruism, he states, "But some people sacrificially give of themselves to those who are outside their group and with whom they have absolutely nothing in common." Absolutely nothing in common? Certainly Collins, being the leader of the Human Genome Project, knows that we share over 98 percent of our genes with chimpanzees, let alone other human beings.

MARK McGINNIS
Maple Shade, New Jersey

As science advances, there is less for religion to do, and supernatural explanations of our world adapt or become extinct. I do not see how religion and science as ways of knowing are logically compatible. And although I welcome the advance of science and the retreat of religion, we must not move too fast. The social mechanisms that serve to organize human behavior evolved over millennia, and we should not overlook the margin of success that they might continue to provide.

LEO CARLIN
York, Pennsylvania

If Collins's God is so non-anthropocentric, as one infers from his interview, what is the point? When a scientist who spends his life working with natural laws espouses "magic," something is amiss.

JACK PEDIGO
Seattle, Washington

The interview with Collins somehow assumes that religion will be necessary as long as there is suffering. I would like to point out that faith can be a way—among others not necessarily religious—to cope not only with suffering but with a sense of wonder and amazement. It's not a lack of suffering that would render religion superfluous, but plain indifference—whether to suffering or to joy.

JORDI COTS
Barcelona, Spain

LETTERS

Expeditions: Signposts to a Lost Culture

As I look at the picture of the deer stone, the purpose seems clear to me. I believe that these stones were used to establish boundaries between tribal territories. If you envision the belt on the stone as representing a valley surrounded by two chains of mountains, the single mark in the center of the bottom leftmost mountain marks the location of the deer stone. The stone marker lays claim to the territory bounded by the mountains, the valley, and the game to be found there, signified by the reindeer depicted. The weapons shown are almost a complete arsenal for the time, a warning that the people that live there are well armed and will protect their territory.

WILLIAM MORENO
Calabasas, California

After searching on Google for "elk" and "moose," I really think that your "mysterious images of antlered creatures with birdlike beaks" are stylized moose. Huge antlers with frontal branches, fleshy neck, tiny tail, and the deciding feature—a soft, pendulous snout. "Deerbird" my eye—it's a moose, dude.

LINDA SCHILLING
Canyon, Texas

Family of Man: Street Food

About ten years ago while visiting a friend in Chicago, we drove to a neighborhood off the beaten path and bought the mango on a stick you described. I have been eating this for years at home. We skip the stick and salt—go heavy on the fresh lime juice and light on the pepper (our supermarket carries a Mexican brand of chili used for fruits). I wish I could remember the part of town I was in, because I have not met anyone else in Chicago who knows. Now that I live in the Midwest, I am surrounded by people who salt ketchup and everything else, including apples and watermelon.

JOANN IVY CONRAD
Springfield, Illinois

THE SURPRISING POWER OF TURNING EXERCISE INTO FUN.

Can a few minutes of getting up and out with your family or friends strengthen bones—and bonds? Research shows that just 15 minutes of exercise each day can cut a child's chance of becoming obese by 50%. Studies indicate that even small bits of activity help to lower our blood pressure, improve memory, and prevent diabetes, heart disease, osteoporosis, depression, and some cancers. Meanwhile, a little active fun with the people in your life not only may add years to your life, but lets you connect on a whole new level. So instead of catching a movie, catch a ball...trade a few serves instead of emails...or just walk and talk around the block together. Sometimes the little things can make the biggest difference of all.

See more simple ideas for healthy living at www.nationalgeographic.com/healthyliving

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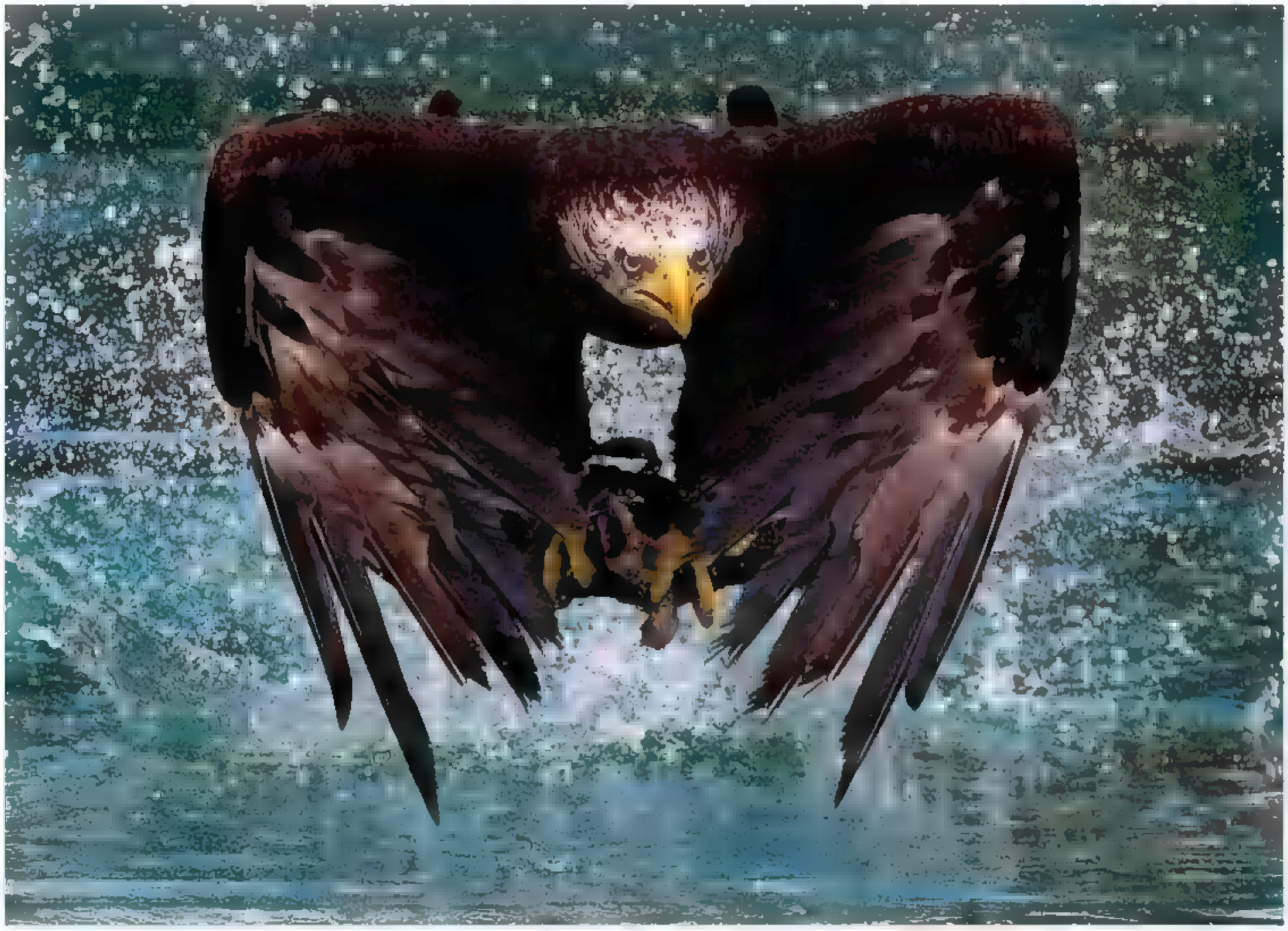
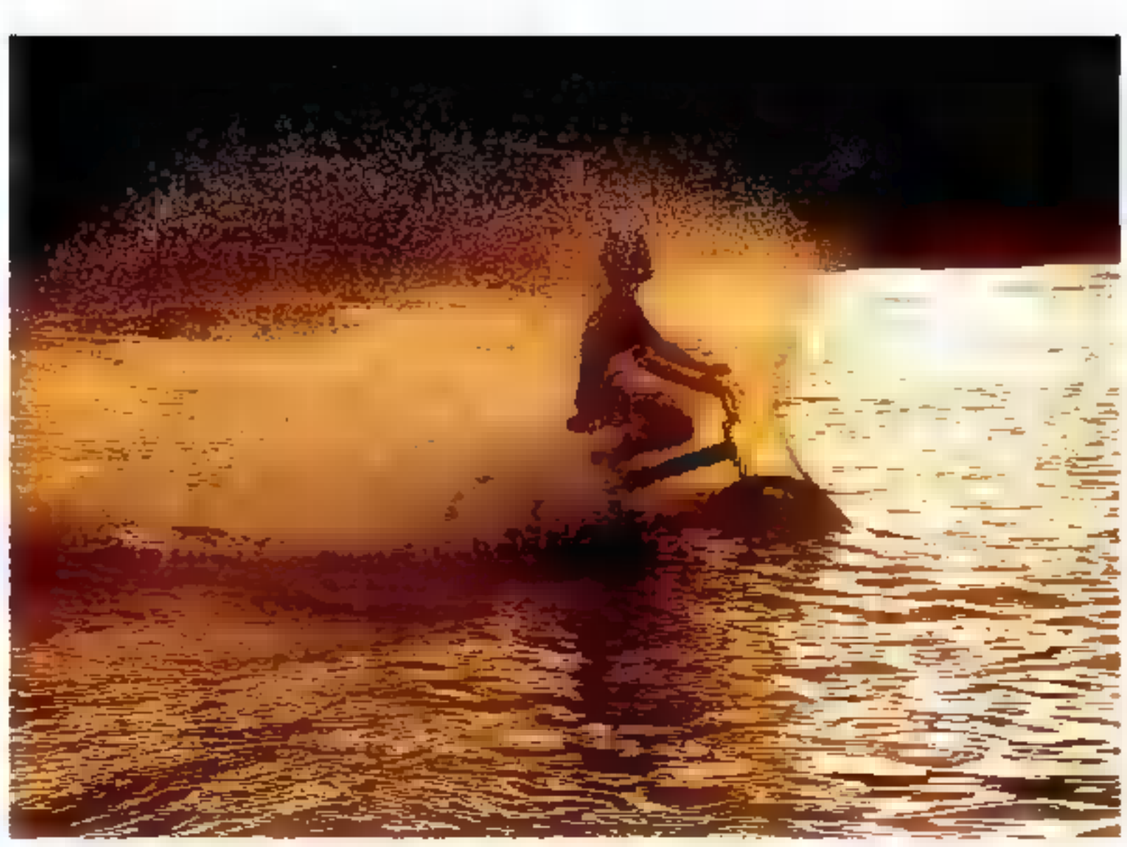
Make a Big Splash Many entries to the Your Shot page were all wet this month—and our editors drank them in. Bathing pilgrims, glistening frogs, diving eagles, and children at play in the spray were just a few of the pictures received. Send us your most refreshing photographs. For guidelines, a submission form, and more information, go to *ngm.com/yourshot.*



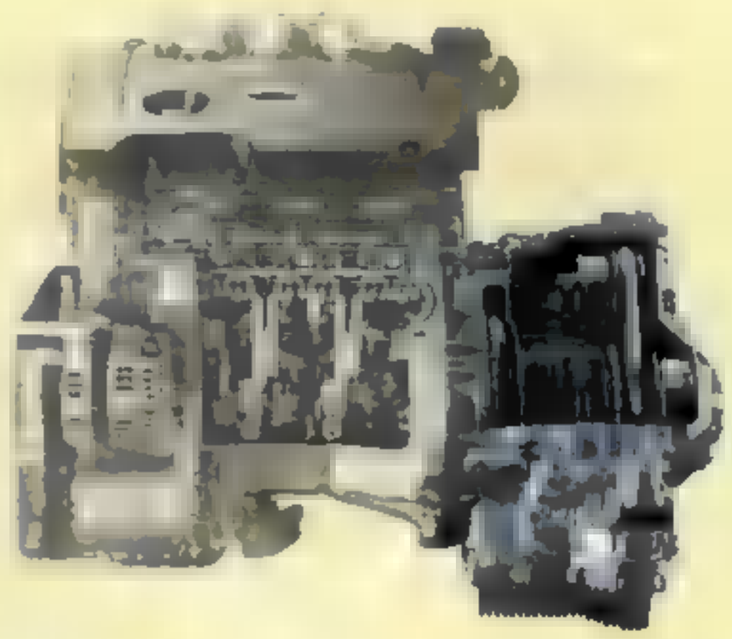
Dean Bertoncelj Zagreb, Croatia

Photographer Dean Bertoncelj was visiting ■ park's raptor show on Spain's Lanzarote island when he snapped this bald eagle snatching a fish. "For a living I shoot fashion and celebrity photography," says Bertoncelj, 38. "But animals are something I enjoy the most."



Samuel Melim Itajaí, Brazil

"I was just getting home when I saw these children driving their bikes through the water," says Samuel Melim, 30, a Web designer. "This shot shows how life is good, and how the little things can be wonderful."



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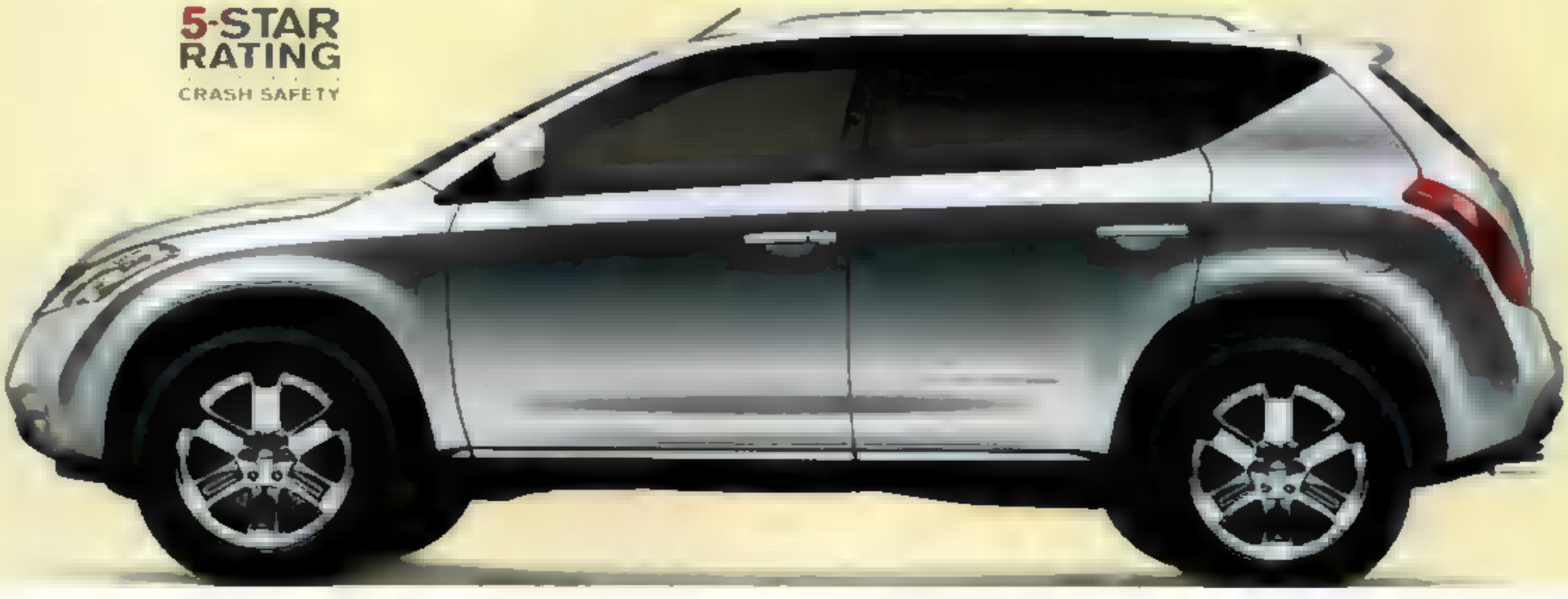

The Nissan Murano

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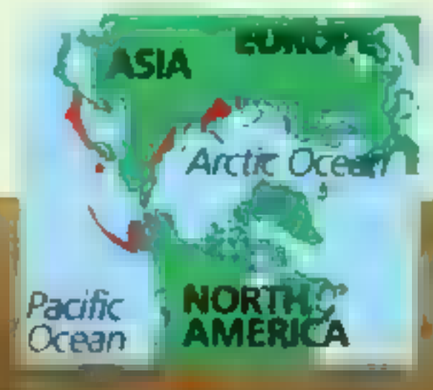
*2007 EPA fuel-economy estimates for Murano 2WD w/CVT are 20 mpg city/25 mpg highway. Actual mileage may vary. Government star ratings are part of the National Highway Traffic Safety Administration's (NHTSA's) New Car Assessment Program (www.safercar.gov). A 5-star rating is the highest government safety rating for driver and right-front-passenger seating positions in frontal crash tests and for front- and rear-passenger seating positions in side-impact crash tests. Model tested was 2007 Murano with standard side-impact air bags. Nissan, the Nissan Brand Symbol, "SHIFT_" tagline and Nissan model names are Nissan trademarks. Tread Lightly!® Please. Always wear your seat belt, and please don't drink and drive.

Bradford Washburn caught this moonrise over the Grandes Jorasses in the French Alps on a 1958 expedition.

Peak Profiler "Failure is always crowned by success *if you persist,*" wrote Bradford Washburn—cartographer, photographer, and mountaineer. Persist he did. In 1921, at age 11, he scaled New Hampshire's Mount Washington. When his boots froze on one overnight trek, he whacked them with an ax to soften them up. In the Alps, he sat on a skinny snow bridge and pushed forward by hand, legs dangling over ■ crevasse. The National Geographic Society funded eight of his expeditions, from the Yukon in 1935 to Mount Everest in 1999, ■ project he ran remotely. The longtime contributor to the magazine would "shake it to its roots" to dispute an editorial call, said Gilbert M. Grosvenor, Chairman of the Board of National Geographic. "He was tenacious, in the good sense." He was careful, too. He told Amelia Earhart to get better radio gear for her round-the-world flight. If she'd listened, she might have made it. Washburn, who died January 10 at age 96, was proudest of founding Boston's Museum of Science, where he climbed stairs to his office into his 90s—when he wasn't playing poker with the guys in the basement. Asked why he kept so active, he'd say, "I'm staying alive, staying alive."

Traveling with cameras large (like this 50-pounder) and small, Washburn took detailed mountainscapes.



Steller's Eider *(Polysticta stelleri)*
Size: Head and body length, 17 - 18 inches; wingspan, approx. 27 inches **Weight:** 1.8 - 2.0 lbs
Habitat: Nests in tundra in coastal areas and large river deltas; molts and winters in shallow nearshore waters and protected lagoons and bays **Surviving number:** Estimated at 126,000 - 144,000 individuals

Photographed by Ted Swem

WILDLIFE AS CANON SEES IT

Appearances count. That's why the male Steller's eider displays striking black, white, chestnut and green plumage for much of the year — hoping to catch the eye of a receptive female. Pomp takes a holiday during late summer and fall, when breeding season ends and the male reverts to an inconspicuous brown. The arctic bird's diet changes with the seasons as well: it feeds on aquatic insects and plants during breeding season, then transitions to mollusks and crustaceans. Each year, fewer and fewer eiders make an appearance in Alaska; subsistence hunting and contaminants are among the factors thought to be causing their steep population declines.

As an active, committed global corporation, we join worldwide efforts to promote awareness of endangered species. Just one way we are working to make the world a better place—today and tomorrow. Visit **ngm.com/canonwildlife** to find out more.

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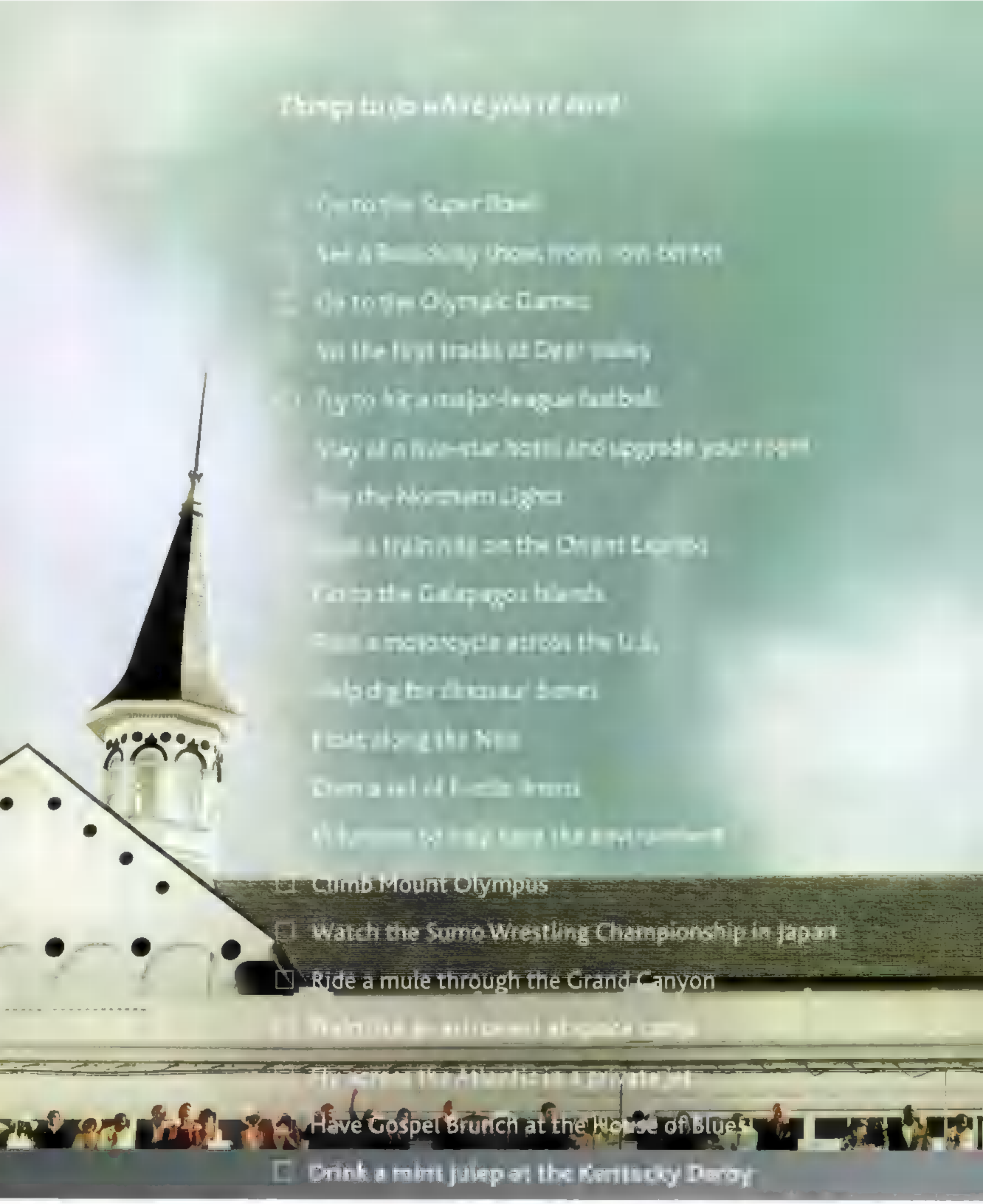

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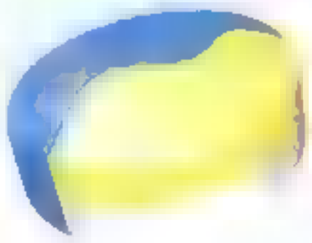
PHOTO JOURNAL | BRADFORD WASHBURN

Washburn captured Alaska's "snowy grandeur" in his 1938 photo of Mount McKinley (above). In 1951, he surveyed McKinley's Kahiltna Dome (right). Fueled by malted milk—his beloved mountain breakfast drink—Washburn was the first man to climb to the 20,320-foot peak three times. His wife, Barbara, who called him "a crazy mountain climber" before they ever met, was the first woman to summit. "He and his wife roamed the world," said Grosvenor, "and together motivated women to join the ranks of premier explorers."

Ambien CR is the only 2-layer sleep aid with a controlled-release formula:



The first layer dissolves quickly to help you get to sleep fast.
The second layer dissolves slowly to help you stay asleep.*†

AMBIEN CR™
(ZOLPIDEM TARTRATE EXTENDED RELEASE) C-IV
6.25-MG & 12.5-MG EXTENDED RELEASE TABLETS

For a limited time only, get 7 days of AMBIEN CR FREE.

Visit www.AmbienCR.com or call 1-800-581-1410.

With AMBIEN CR, getting to sleep fast and staying asleep helps you wake up and get ready for the day.** AMBIEN CR is a treatment option you and your healthcare provider can consider along with lifestyle changes and can be taken for as long as your healthcare provider recommends. Ask your healthcare provider about the latest AMBIEN, AMBIEN CR — and don't forget to mention the CR.

**Proven effective for up to 7 hours in clinical studies.* ***Individual results may vary.*

Important Safety Information

AMBIEN is indicated for the short-term treatment of insomnia.

When you first start taking AMBIEN, use caution in the morning when engaging in activities requiring complete alertness until you know how you will react to this medication. In most instances, memory problems can be avoided if you take AMBIEN only when you are able to get a full night's sleep (7 to 8 hours) before you need to be active again. As with any sleep medication, do not use alcohol while you are taking AMBIEN.

Prescription sleep aids are often taken for 7 to 10 days — or longer as advised by your healthcare provider. Like most sleep medicines, it has some risk of dependency.

There is a low occurrence of side effects associated with the short-term use of AMBIEN. The most commonly observed side effects in controlled clinical trials were drowsiness (2%), dizziness (1%), and diarrhea (1%).

AMBIEN CR is indicated for treating insomnia.

It is a treatment option you and your healthcare provider can consider along with lifestyle changes and can be taken for as long as your healthcare provider recommends. Until you know how AMBIEN CR will affect you, you shouldn't drive or operate machinery. Be sure you're able to devote 7 to 8 hours to sleep before being active again. Side effects may include next-day drowsiness, dizziness and headache. It's non-narcotic; however, like most sleep medicines, it has some risk of dependency. Don't take it with alcohol.

sanofi aventis

†Not actual pill size. Please see important patient information on adjoining page. US.ACR.06.12.043 December 2006 Printed in USA

INFORMATION FOR PATIENTS
Ambien CR™ @
(zolpidem tartrate extended-release) tablets

AMBIEN CR™
(ZOLPIDEM TARTRATE EXTENDED RELEASE) C-IV
6.25-MG & 12.5-MG EXTENDED RELEASE TABLETS

INFORMATION FOR PATIENTS TAKING AMBIEN CR

Your doctor has prescribed Ambien CR to help you sleep. The following information is intended to guide you in the safe use of this medicine. It is not meant to take the place of your doctor's instructions. If you have any questions about Ambien CR tablets be sure to ask your doctor or pharmacist.

Ambien CR is used to treat different types of sleep problems, such as:

- trouble falling asleep
- waking up often during the night

Some people may have more than one of these problems.

Ambien CR belongs to a group of medicines known as the "sedative/hypnotics", or simply, sleep medicines. There are many different sleep medicines available to help people sleep better. Sleep problems are usually temporary, requiring treatment for only a short time, usually 1 or 2 days up to 1 or 2 weeks. Some people have chronic sleep problems that may require more prolonged use of sleep medicine. However, you should not use these medicines for long periods without talking with your doctor about the risks and benefits of prolonged use.

SIDE EFFECTS

Most common side effects:

- headache
- somnolence (sleepiness)
- dizziness

You may find that these medicines make you sleepy during the day. How drowsy you feel depends upon how your body reacts to the medicine, which sleep medicine you are taking, and how large a dose your doctor has prescribed. Daytime drowsiness is best avoided by taking the lowest dose possible that will still help you sleep at night. Your doctor will work with you to find the dose of Ambien CR that is best for you.

To manage these side effects while you are taking this medicine:

- When you first start taking Ambien CR or any other sleep medicine until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
- NEVER drink alcohol while you are being treated with Ambien CR or any sleep medicine. Alcohol can increase the side effects of Ambien CR or any other sleep medicine.
- Do not take any other medicines without asking your doctor first. This includes medicines you can buy without a prescription. Some medicines can cause drowsiness and are best avoided while taking Ambien CR.
- Always take the exact dose of Ambien CR prescribed by your doctor. Never change your dose without talking to your doctor first.

SPECIAL CONCERNS

There are some special problems that may occur while taking sleep medicines.

Memory problems: Sleep medicines may cause a special type of memory loss or "amnesia." When this occurs, a person may not remember what has happened for several hours after taking the medicine. This is usually not a problem since most people fall asleep after taking the medicine.

Memory loss can be a problem, however, when sleep medicines are taken while traveling, such as during an airplane flight and the person wakes up before the effect of the medicine is gone. This has been called "traveler's amnesia."

Be sure to talk to your doctor if you think you are having memory problems. Although memory problems are not very common while taking Ambien CR, in most instances, they can be avoided if you take Ambien CR only when you are able to get a full night's sleep (7 to 8 hours) before you need to be active again.

Tolerance: When sleep medicines are used every night for more than a few weeks, they may lose their effectiveness to help you sleep. This is known as "tolerance". Sleep medicines should, in most cases, be used only for short periods of time, such as 1 or 2 days and generally no longer than 1 or 2 weeks. If your sleep problems continue, consult your doctor, who will determine whether other measures are needed to overcome your sleep problems.

Dependence: Sleep medicines can cause dependence, especially when these medicines are used regularly for longer than a few weeks or at high doses. Some people develop a need to continue taking their medicines. This is known as dependence or "addiction."

When people develop dependence, they may have difficulty stopping the sleep medicine. If the medicine is suddenly stopped, the body is not able to function normally and unpleasant symptoms may occur (see *Withdrawal*). They may find that they have to keep taking the medicines either at the prescribed dose or at increasing doses just to avoid withdrawal symptoms.

All people taking sleep medicines have some risk of becoming dependent on the medicine. However, people who have been dependent on alcohol or other drugs in the past may have a higher chance of becoming addicted to sleep medicines. This possibility must be considered before using these medicines for more than a few weeks.

If you have been addicted to alcohol or drugs in the past, it is important to tell your doctor before starting Ambien or any sleep medicine.

Withdrawal: Withdrawal symptoms may occur when sleep medicines are stopped suddenly after being used daily for a long time. In some cases, these symptoms can occur even if the medicine has been used for only a week or two.

In mild cases, withdrawal symptoms may include unpleasant feelings. In more severe cases, abdominal and muscle cramps, vomiting, sweating, shakiness, and rarely, seizures may occur. These more severe withdrawal symptoms are very uncommon.

Another problem that may occur when sleep medicines are stopped is known as "rebound insomnia." This means that a person may have more trouble sleeping the first few nights after the medicine is stopped than before starting the medicine. If you should experience rebound insomnia, do not get discouraged. This problem usually goes away on its own after 1 or 2 nights.

If you have been taking Ambien CR or any other sleep medicine for more than 1 or 2 weeks, do not stop taking it on your own. Always follow your doctor's directions.

Changes in behavior and thinking: Some people using sleep medicines have experienced unusual changes in their thinking and/or behavior. These effects are not common. However, they have included:

- more outgoing or aggressive behavior than normal
- confusion
- strange behavior
- agitation
- hallucinations
- worsening of depression
- suicidal thoughts

How often these effects occur depends on several factors, such as a person's general health, the use of other medicines, and which sleep medicine is being used.

It is also important to realize that it is rarely clear whether these behavior changes are caused by the medicine, an illness, or occur on their own. In fact, sleep problems that do not improve may be due to illnesses that were present before the medicine was used. If you or your family notice any changes in your behavior, or if you have any unusual or disturbing thoughts, call your doctor immediately.

"Sleep-Driving" and other complex behaviors: There have been reports of people getting out of bed after taking a sedative-hypnotic and driving their cars while not fully awake, often with no memory of the event. If you experience such an event, it should be reported to your doctor immediately, since "sleep-driving" can be dangerous. This behavior is more likely to occur when Ambien CR is taken with alcohol or other drugs such as those for the treatment of depression or anxiety. Other complex behaviors such as preparing and eating food, making phone calls, or having sex have been reported in people who are not fully awake after taking a sleep medicine. As with sleep-driving, people usually do not remember these events.

Pregnancy: Sleep medicines may cause sedation of the unborn baby when used during the last weeks of pregnancy.

Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien CR.

SAFE USE OF SLEEPING MEDICINES

To ensure the safe and effective use of Ambien CR or any other sleep medicine, you should observe the following cautions:

1. Ambien CR is a prescription medicine and should be used ONLY as directed by your doctor. Follow your doctor's instructions about how to take, when to take, and how long to take Ambien CR. Ambien CR tablets should not be divided, crushed, or chewed, and must be swallowed whole.
2. Never use Ambien CR or any other sleep medicine for longer than directed by your doctor.
3. If you develop an allergic reaction such as rash, hives, shortness of breath or swelling of your tongue or throat when using Ambien CR or any other sleep medicine, discontinue Ambien CR or other sleep medicine immediately and contact your doctor.
4. If you notice any unusual and/or disturbing thoughts or behavior during treatment with Ambien CR or any other sleep medicine, contact your doctor.
5. Tell your doctor about any medicines you may be taking, including medicines you may buy without a prescription. You should also tell your doctor if you drink alcohol. DO NOT use alcohol while taking Ambien CR or any other sleep medicine.
6. Do not take Ambien CR unless you are able to get a full night's sleep before you must be active again. For example, Ambien CR should not be taken on an overnight airplane flight of less than 7 to 8 hours since "traveler's amnesia" may occur.
7. Do not increase the prescribed dose of Ambien CR or any other sleep medicine unless instructed by your doctor.
8. When you first start taking Ambien CR or any other sleep medicine, until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
9. Be aware that you may have more sleeping problems the first night after stopping Ambien CR or any other sleep medicine.
10. Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien CR or any other sleep medicine.
11. As with all prescription medicines, never share Ambien CR or any other sleep medicine with anyone else. Always store Ambien CR or any other sleep medicine in the original container that you received it in and store it out of reach of children.
12. Ambien CR works very quickly. You should only take Ambien CR right before going to bed and are ready to go to sleep.

AMBCR-MAR07A-IFP-Ad

Revised March 2007A

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INFORMATION FOR PATIENTS
Ambien® ℞
(zolpidem tartrate)

AMBIEN® (ZOLPIDEM TARTRATE) C-IV

INFORMATION FOR PATIENTS TAKING AMBIEN

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- trouble falling asleep
- waking up too early in the morning
- waking up often during the night

Some people may have more than one of these problems.

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SIDE EFFECTS

Most common side effects: All medicines have side effects. Most common side effects of sleep medicines include

- drowsiness
- dizziness
- lightheadedness
- difficulty with coordination

You may find that these medicines make you sleepy during the day. How drowsy you feel depends upon how your body reacts to the medicine, which sleep medicine you are taking, and how large a dose your doctor has prescribed. Daytime drowsiness is best avoided by taking the lowest dose possible that will still help you sleep at night. Your doctor will work with you to find the dose of Ambien that is best for you.

To manage these side effects while you are taking this medicine:

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Memory problems are not common while taking Ambien. In most instances memory problems can be avoided if you take Ambien only when you are able to get a full night's sleep (7 to 8 hours) before you need to be active again. Be sure to talk to your doctor if you think you are having memory problems.

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When people develop dependence, they may have difficulty stopping the sleep medicine. If the medicine is suddenly stopped, the body is not able to function normally and unpleasant symptoms (see *Withdrawal*) may occur. They may find they have to keep taking the medicine either at the prescribed dose or at increasing doses just to avoid withdrawal symptoms.

All people taking sleep medicines have some risk of becoming dependent on the medicine. However, people who have been dependent on alcohol or other drugs in the past may have a higher chance of becoming addicted to sleep medicines. This possibility must be considered before using these medicines for more than a few weeks. If you have been addicted to alcohol or drugs in the past, it is important to tell your doctor before starting Ambien or any sleep medicine.

Withdrawal: Withdrawal symptoms may occur when sleep medicines are stopped suddenly after being used daily for a long time. In some cases, these symptoms can occur even if the medicine has been used for only a week or two.

In mild cases, withdrawal symptoms may include unpleasant feelings. In more severe cases, abdominal and muscle cramps, vomiting, sweating, shakiness, and rarely, seizures may occur. These more severe withdrawal symptoms are very uncommon.

Another problem that may occur when sleep medicines are stopped is known as "rebound insomnia." This means that a person may have more trouble sleeping the first few nights after the medicine is stopped than before starting the medicine. If you should experience rebound insomnia, do not get discouraged. This problem usually goes away on its own after 1 or 2 nights.

If you have been taking Ambien or any other sleep medicine for more than 1 or 2 weeks, do not stop taking it on your own. Always follow your doctor's directions.

Changes in behavior and thinking: Some people using sleep medicines have experienced unusual changes in their thinking and/or behavior. These effects are not common. However, they have included:

- more outgoing or aggressive behavior than normal
- loss of personal identity
- confusion
- strange behavior
- agitation
- hallucinations
- worsening of depression
- suicidal thoughts

How often these effects occur depends on several factors, such as a person's general health, the use of other medicines, and which sleep medicine is being used. Clinical experience with Ambien suggests that it is uncommonly associated with these behavior changes.

It is also important to realize that it is rarely clear whether these behavior changes are caused by the medicine, an illness, or occur on their own. In fact, sleep problems that do not improve may be due to illnesses that were present before the medicine was used. If you or your family notice any changes in your behavior, or if you have any unusual or disturbing thoughts, call your doctor immediately.

"Sleep-Driving" and other complex behaviors: There have been reports of people getting out of bed after taking a sleep medicine and driving their cars while not fully awake, often with no memory of the event. If you experience such an event, it should be reported to your doctor immediately, since "sleep-driving" can be dangerous. This behavior is more likely to occur when Ambien is taken with alcohol or other drugs such as those for the treatment of depression or anxiety. Other behaviors such as preparing and eating food, making phone calls, or having sex have been reported in people who are not fully awake after taking a sleep medicine. As with sleep-driving, people usually do not remember these events.

Pregnancy: Sleep medicines may cause sedation of the unborn baby when used during the last weeks of pregnancy.

Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien.

SAFE USE OF SLEEPING MEDICINES

To ensure the safe and effective use of Ambien or any other sleep medicine, you should observe the following cautions:

1. Ambien is a prescription medicine and should be used ONLY as directed by your doctor. Follow your doctor's instructions about how to take, when to take, and how long to take Ambien.
2. Never use Ambien or any other sleep medicine for longer than directed by your doctor.
3. If you develop an allergic reaction such as a rash, hives, shortness of breath, or swelling of your tongue or throat when using Ambien or any other sleep medicine, discontinue Ambien or other sleep medicine immediately and contact your doctor.
4. If you notice any unusual and/or disturbing thoughts or behavior during treatment with Ambien or any other sleep medicine, contact your doctor.
5. Tell your doctor about any medicines you may be taking, including medicines you may buy without a prescription. You should also tell your doctor if you drink alcohol. DO NOT use alcohol while taking Ambien or any other sleep medicine.
6. Do not take Ambien unless you are able to get a full night's sleep before you must be active again. For example, Ambien should not be taken on an overnight airplane flight of less than 7 to 8 hours since "traveler's amnesia" may occur.
7. Do not increase the prescribed dose of Ambien or any other sleep medicine unless instructed by your doctor.
8. When you first start taking Ambien or any other sleep medicine until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
9. Be aware that you may have more sleeping problems the first night or two after stopping Ambien or any other sleep medicine.
10. Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien.
11. As with all prescription medicines, never share Ambien or any other sleep medicine with anyone else. Always store Ambien or any other sleep medicine in the original container out of reach of children.
12. Ambien works very quickly. You should only take Ambien right before going to bed and are ready to go to sleep.

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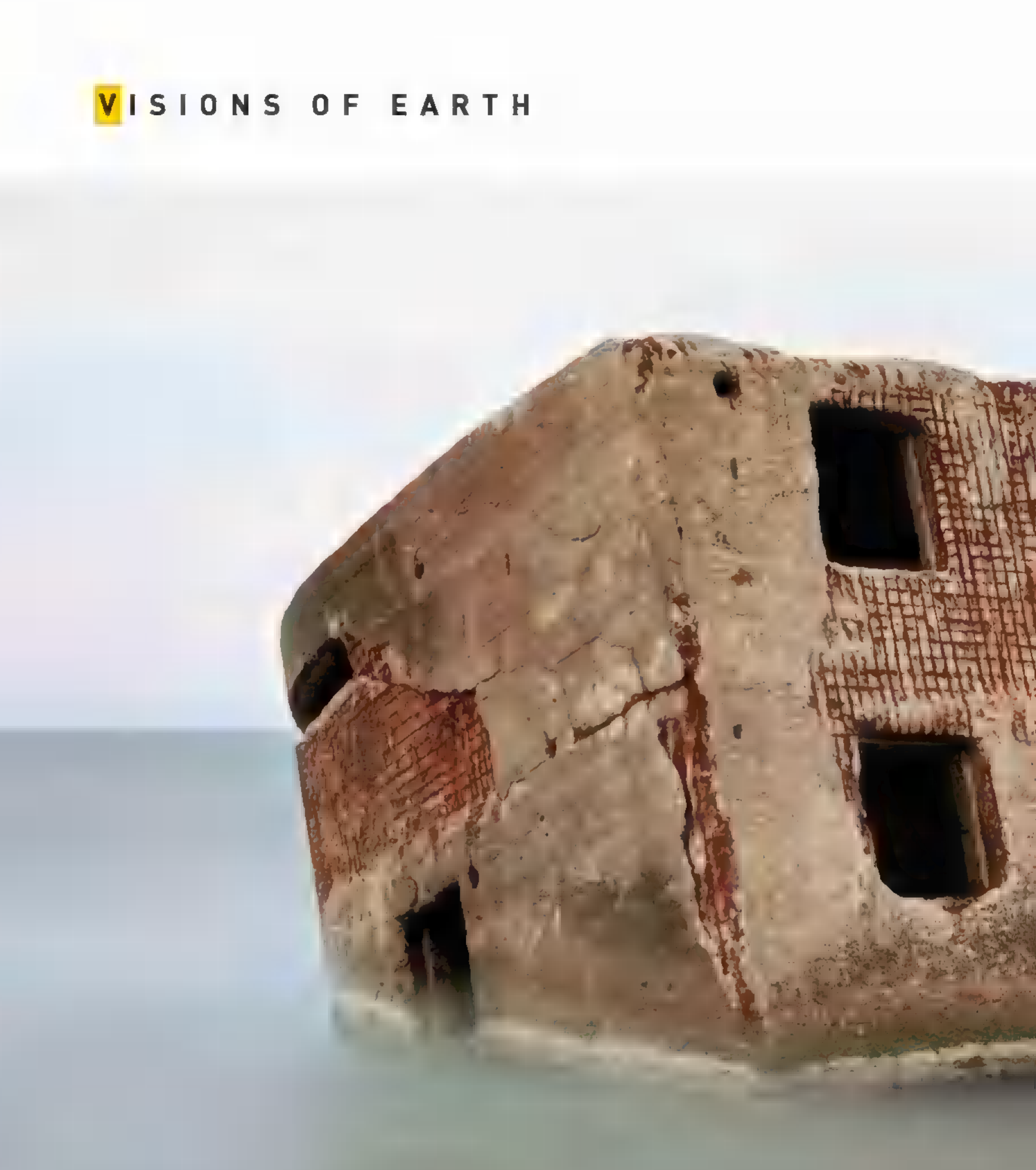

Latvia A long exposure blurs sea and sky into a minimalist backdrop for a crumbling Soviet-era military building near Liepāja. More than a decade after Moscow withdrew its forces from Latvia, such ruins litter the Baltic coast.

PHOTO: MARTIN ROEMERS, PANOS PICTURES

New Zealand Comet McNaught exuberantly trumps the town of Ashburton's electric glow. Discovered by Australian astronomer Robert McNaught in 2006, the comet put on the brightest show of its kind in 40 years.

PHOTO: EUAN G. MASON, CANTERBURY ASTRONOMICAL SOCIETY

Ukraine A frosted car window frames families bustling to ■ church in Vorokhta. Suppressed during Soviet rule, churches are potent symbols of independence, even for Ukrainians who rarely attend.

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PHOTO: CAROLYN DRAKE


6
HUMAN
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THEY RUN TO INSPIRE A PLANET. Twenty runners. Sixteen countries. One goal. DOW to generate awareness of the need for clean drinking water throughout the world. It's the Blue Planet Run. Runners helping the people who are helping the planet. It's just one of the things The Dow Chemical Company does when it looks at life through the eyes of the Human Element.

The 7-foot-plus terror bird did not coexist with humans. If it had, this 5-foot-8-incher could've been dinner.

Killer Beak At nearly 400 pounds, the world's biggest known bird didn't fly. But it could have outrun an Olympic sprinter, say paleontologists Luis Chiappe and Sara Bertelli of the Natural History Museum of Los Angeles County. The pair gleaned these details from ■ horse-size skull with a hooked beak and foot bones encased in ■ 15-million-year-old layer of Patagonian rock. Chiappe says the newly identified species, the largest of a group of carnivores called terror birds, likely chased down rabbit-size mammals and killed them with its lethal beak.

Terror birds reigned as South America's top predators after dinosaurs died out 65 million years ago, but the avian giants vanished some two million years ago. One possible explanation: When the land bridge linking the Americas formed, big cats, dogs, bears, and other large carnivores migrated south. Says Chiappe: "These may have driven terror birds to extinction." *—Peter Gwin*

Guillermo Oscar Aguirrezabala, 22, found the bird's skull in 1999 near his home in Comallo, Argentina.

ART: JOHN SIBBICK. PHOTO: IRA BLOCK

Roadtrippin'

ODYSSEY

1. You're So Van
2. Whole Lotta' Leather
3. Takin' [illegible] to the Speed Limit
4. 15 Cup-Holders of Love
5. Runnin' on All Six Cylinders
6. The Magic Third Row
7. We'll Get There Together (The Navi song)
8. Honky Tonkin' Soccer Momma
9. Van [illegible] Fools
10. These Wheels Were Made for Errands
11. 244 Wild Horses
12. I'd Like to Teach the World to Carpool

The funkadelic soul of the Odyssey is at its best in this original sheet-metal collection. Performance-heads will groove to a level of handling and power typically absent from releases in this genre. And there is no better embodiment of Honda's "Safety for Everyone" philosophy than this collection of active and passive safety features. Lifelong fans can rest assured there are many ties to Honda's earlier releases—signature reliability and exacting engineering are evident in each Odyssey performance. So, sit back and get into the groove of the Roadtrippin' experience.

RESPECT THE VAN. THE ODYSSEY. HONDA

honda.com 1-800-33-Honda. Touring model shown. †EX-L and Touring models only; in the 48 contiguous United States on EX-L models with DVD Entertainment System, and on Touring models. ‡Honda Satellite-Linked Navigation System™ is available only

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Ask your doctor about Lyrica®.

Do you feel stabbing pain in your feet?
Or tingling, numbness, shooting or burning sensations?

If so, you may have painful neuropathy, also known as nerve pain. This type of pain is different from musculoskeletal (muscle or joint) pain, and may need a different type of treatment. Only Lyrica is FDA-approved to treat two of the most common types of nerve pain, Diabetic Nerve Pain and Pain after Shingles. Lyrica is specially designed to provide the relief you need. It works on the nerves that cause this pain. So you can start to think about other things besides your pain. Ask your doctor if Lyrica can help. Lyrica is one of several treatments for you and your doctor to consider.

Prescription Lyrica is not for everyone. Some of the most common side effects of Lyrica are dizziness and sleepiness. Others are dry mouth, swelling of hands and feet, blurry vision, weight gain, and trouble concentrating. You may have a higher chance of swelling or gaining weight if you are also taking certain diabetes medicines. And, if you drink alcohol or take medicines that make you sleepy, you may feel more sleepy when you start Lyrica. You should not drive a car or work with machines until you know how Lyrica affects you. Tell your doctor about any changes in your eyesight, muscle pain along with a fever or tired feeling, or skin sores due to diabetes. Also tell your doctor if you are planning to father a child. If you have had a drug or alcohol problem, you may be more likely to misuse Lyrica. You should talk with your doctor before you stop taking Lyrica or any other prescription medication. *Please see important product information on adjacent page.*

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IMPORTANT FACTS

LYRICA® PREGABALIN capsules (LEER-i-kah)

IMPORTANT SAFETY INFORMATION ABOUT LYRICA

LYRICA may make you feel dizzy or sleepy.

- Do not drive a car, work with machines, or do other dangerous things until you are sure you will be alert. Ask your doctor when it is okay to do these things.

LYRICA may cause problems with your eyesight, including blurry vision. Call your doctor if you have any changes in your eyesight.

ABOUT LYRICA

LYRICA is a prescription medicine used to treat:

- Nerve pain from diabetes
- Nerve pain that continues after the rash from shingles heals

This pain can be sharp or burning. It can feel like tingling, shooting, or numbness. Some people taking LYRICA had less pain by the end of the first week. LYRICA may not work for everyone.

WHO IS LYRICA FOR?

Who can take LYRICA:

- Adults 18 years or older with nerve pain from diabetes or after shingles

Who should NOT take LYRICA:

- Anyone who is allergic to anything in LYRICA

LYRICA has not been studied for nerve pain in children under 18 years of age.

BEFORE STARTING LYRICA

Tell your doctor about all your medical conditions.
Tell your doctor if you:

- Have or had kidney problems or dialysis
- Have heart problems, including heart failure
- Have a bleeding problem or a low blood platelet count
- Have abused drugs or alcohol. LYRICA may cause some people to feel "high."
- Are either a man or woman planning to have children or a woman who is breast-feeding, pregnant, or may become pregnant. ■ is not known if LYRICA may decrease male fertility, cause birth defects, or pass into breast milk.

Tell your doctor about all your medicines. Include over-the-counter medicines, vitamins, and herbal products. Tell your doctor if you take:

- Rosiglitazone (Avandia*)* or pioglitazone (Actos*)** for diabetes
- Narcotic pain medicines such as oxycodone, tranquilizers, or medicines for anxiety such as lorazepam
- Any medicines that make you sleepy

LYU00066E

POSSIBLE SIDE EFFECTS OF LYRICA

LYRICA may cause serious side effects, including:

- Dizziness and sleepiness
- Eyesight problems
- Weight gain and swelling of hands and feet. Weight gain may affect control of diabetes. Weight gain and swelling can be serious for people with heart problems.
- Unexplained muscle pain, soreness, or weakness along with a fever or tired feeling. If you have these symptoms, tell your doctor right away.
- Skin sores. In LYRICA studies, skin sores were seen in animals but not in humans. If you have diabetes, pay extra attention to your skin. Tell your doctor about any skin problems.

The most common side effects of LYRICA are:

- Dizziness
- Sleepiness
- Swelling of hands and feet
- Blurry vision
- Weight gain
- Trouble concentrating
- Dry mouth

You may have a higher chance of swelling or gaining weight if you are taking certain diabetes medicines with LYRICA. Medicines that already make you sleepy or dizzy may make you feel more sleepy or dizzy with LYRICA.

HOW TO TAKE LYRICA

Do:

- Take LYRICA exactly as your doctor tells you. Your doctor may tell you to take it 2 or 3 times a day.
- Take LYRICA with or without food.

Don't:

- Do not drive a car or use machines if you feel sleepy while taking LYRICA.
- Do not drink alcohol or use other medicines that make you sleepy while taking LYRICA.
- Do not change the dose or stop LYRICA suddenly. You may have headaches, nausea, diarrhea, or trouble sleeping if you stop taking LYRICA suddenly.
- Do not start any new medicines without first talking to your doctor.

NEED MORE INFORMATION?

- Ask your doctor or pharmacist. This is only a brief summary of important information.
- Go to **www.lyrica.com** or call **1-888-9-LYRICA (1-888-959-7422).**

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PBIF Rev. 1, May 2006

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	Mined Flawless Diamond	Diamond*Aura* Compares to:
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Color	"D" Colorless	"D" Colorless
Clarity	"IF"	"F" Faultless
Dispersion/Fire	0.044	0.066
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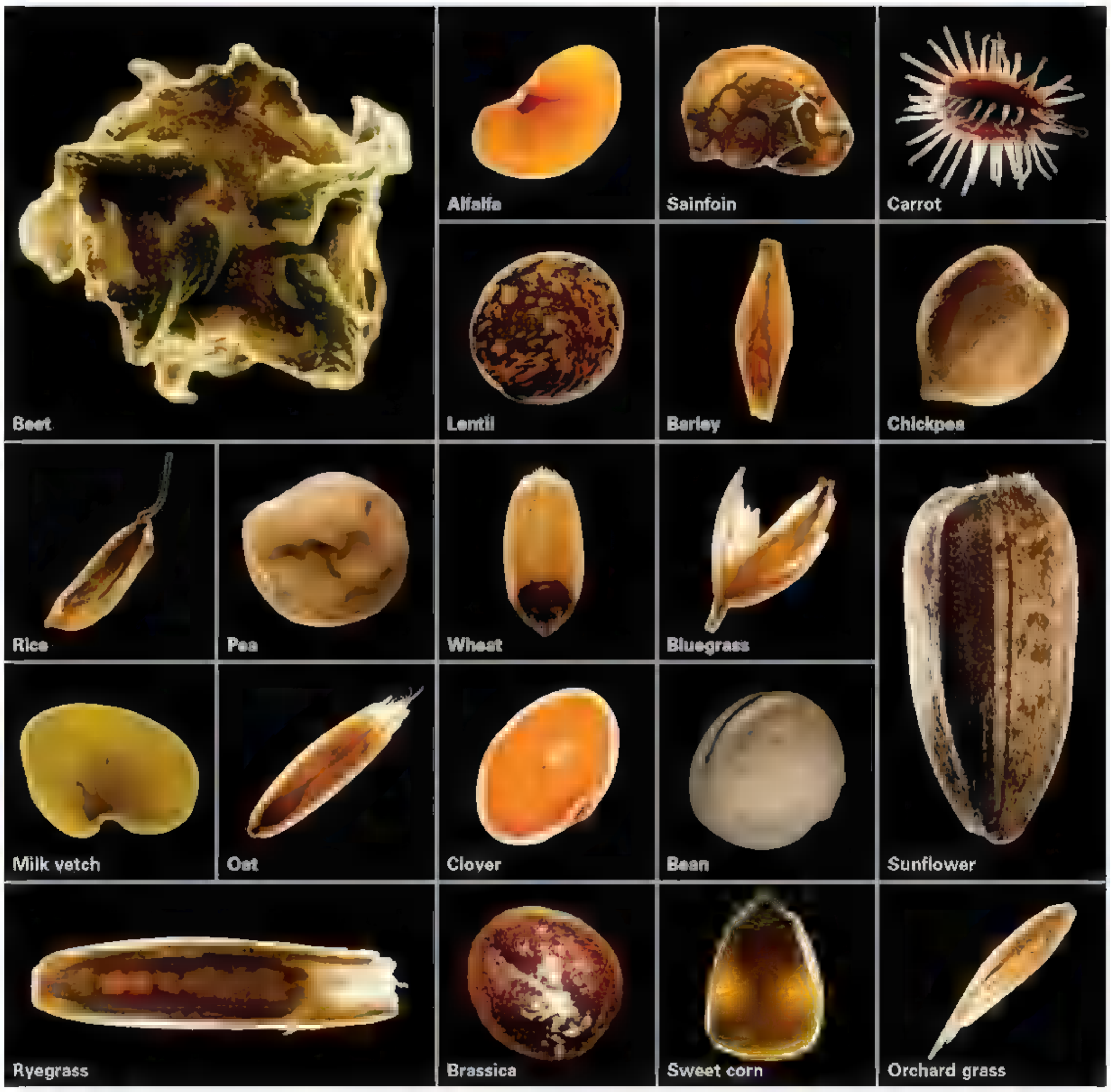

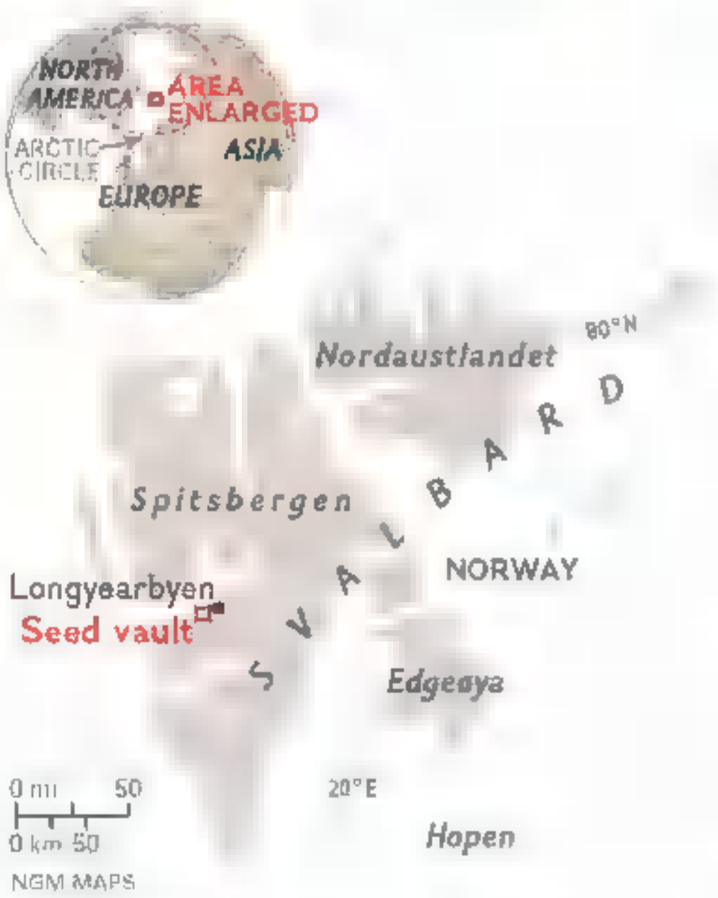

Norway's Ark

We're often told to back up our hard drives—save that data or ■ virus could erase family photos, tax forms, or ■ novel in progress. But we rarely think about safeguarding our food from catastrophe. On the Norwegian island of Spitsbergen, work began in spring on a vault to protect seeds from the world's most important crops against the potential ravages of war, disease, or cataclysm. Carved into stone beneath the Arctic island's permafrost skin and designed to survive nuclear and other disasters, the bank will hold up to three million seeds from key plants (above). The dedication is slated for March 2008. The Global Crop Diversity Trust is spearheading the project, with funding from Norway. Nations across the globe are contributing seeds of local crops, which will be locked away in cold storage, just in case. *—Neil Shea*

PHOTOS: VIKTOR SYKORA. SEED SOURCE: USDA NATIONAL CENTER FOR GENETIC RESOURCES PRESERVATION

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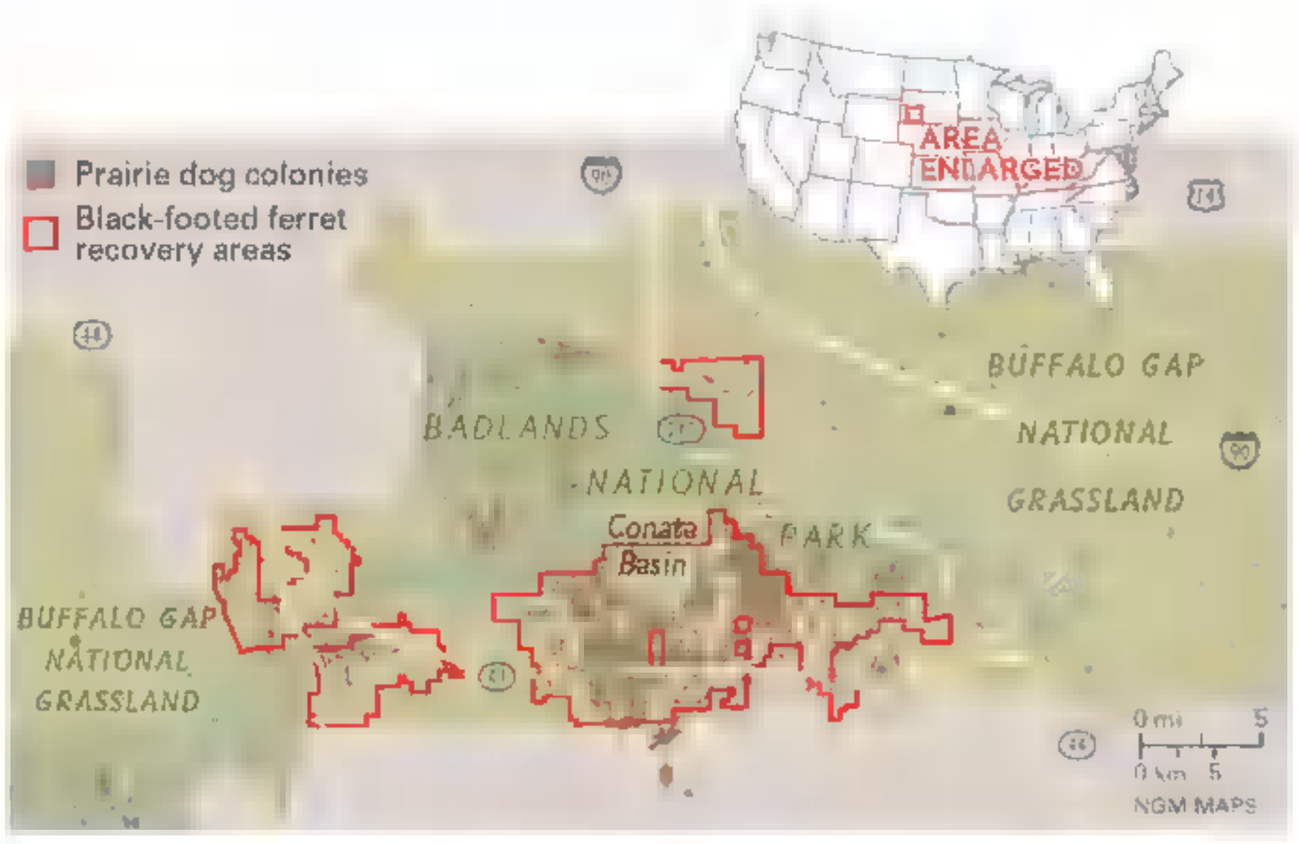
Face Detection

Ferret Warning

The stealthy black-footed ferret lives and dies with the prairie dog. And a plan to poison dog colonies could put many of the ferrets on ■ starvation diet. Nearly extinct 25 years ago, the ferret lives in prairie dog burrows and at night preys on the rodents—its main food source. Unfortunately, ranchers have no love for black-tailed prairie dogs, which eat the grass that feeds cattle. After six years of low rainfall in South Dakota's Buffalo Gap National Grassland, where 30,000 cattle graze in a year, a few ranchers want help. The U.S. Forest Service is considering a plan that could allow prairie dog poisoning in the grassland—including Conata Basin, home to the largest group of black-footed ferrets, which have made a fragile recovery after loss of habitat dropped numbers to near zero. "We don't intend to jeopardize the ferret population," says Don Bright of the Forest Service, who will announce the decision October 1. Conservationists say any action that shrinks prairie dog habitat will harm ferrets—one of America's most endangered mammals. *—Tom O'Neill*



Habitat loss has cut wild black-footed ferret numbers to approximately 700. A reintroduced population of about 250 lives in Conata Basin.

PHOTO: JOEL SARTORE; MAP DATA JONATHAN PROCTOR, DEFENDERS OF WILDLIFE

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Dr. Sylvia Earle's office covers two thirds of the Earth's surface. [illegible] is a little more difficult to define. Marine biol[illegible] Oceanographer. Botanist. Aquanaut. And explorer. She's spent more than 6,000 hours underwater, discovering things we never knew existed. At 1,250 feet, she set the world record for the deepest untethered, solo ocean dive. To Dr. Earle, it was just one more thing in the endless pursuit of science.

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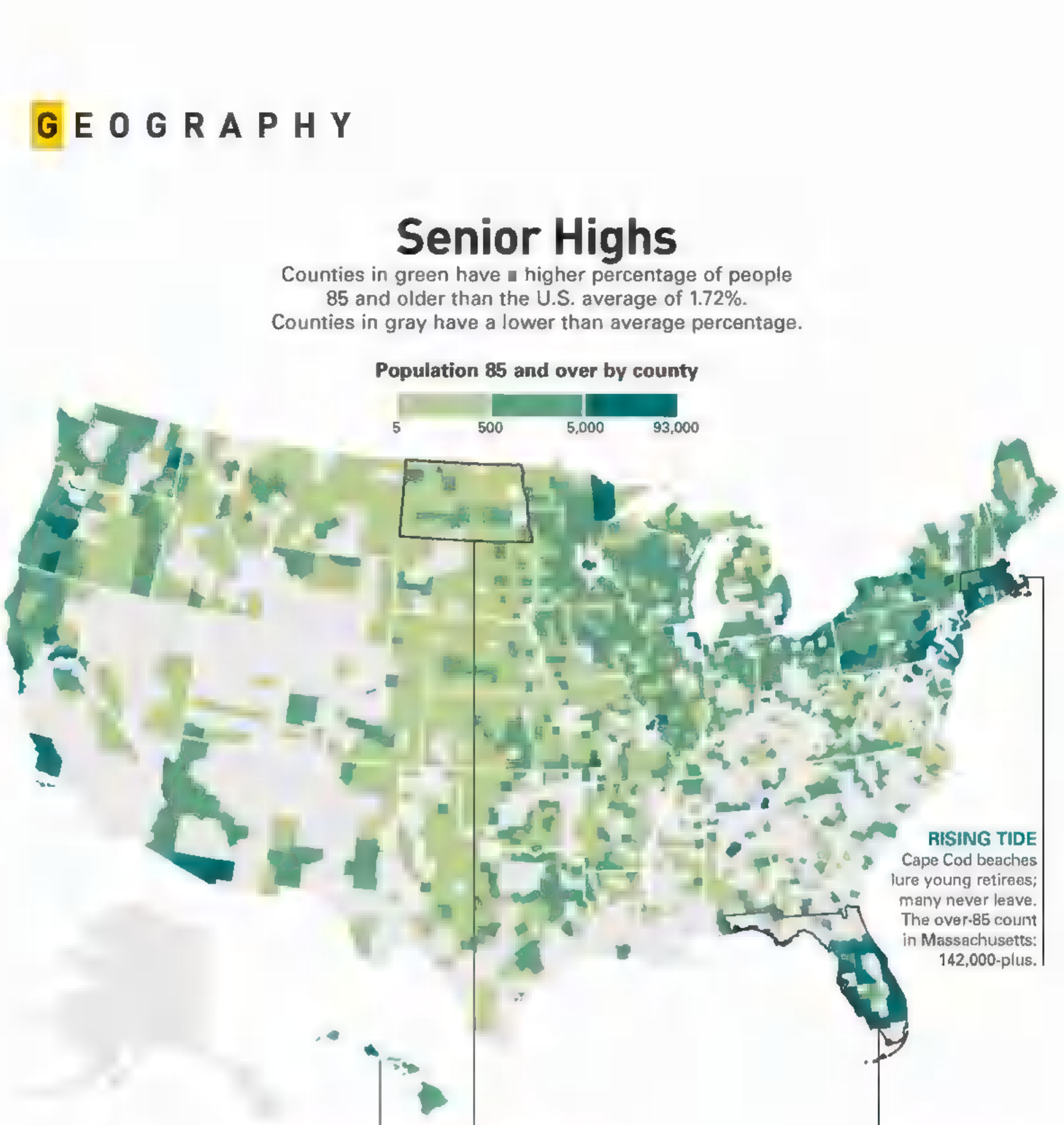
Senior Highs

Counties in green have ■ higher percentage of people 85 and older than the U.S. average of 1.72%. Counties in gray have a lower than average percentage.



Attention, Madison Avenue: The 85-and-older set is the fastest growing slice of the U.S. population. In 2005, the so-called "old old" topped 5 million; by 2050, the number is expected to hit 20 million. Large chunks of the Midwest have a (relatively) high percentage of older seniors. But that's mostly because young people are leaving for jobs elsewhere. Boston and San Francisco suburbs have also grown grayer as more seniors age in place. Exercise is part of the 21st-century senior lifestyle. Marge Jetton (left), 102, of Loma Linda, California, pumps iron to keep fit. But some things haven't changed: Early birds still get a fine selection of 4 p.m. dinner options in Florida. *—Alan Mairson*

SOURCE: U.S. CENSUS BUREAU. NGM MAPS. PHOTO: DAVID McLAIN

Jess Jackson, Upper Hawkeye Mountain Estate, Alexander Valley

KENDALL-JACKSON

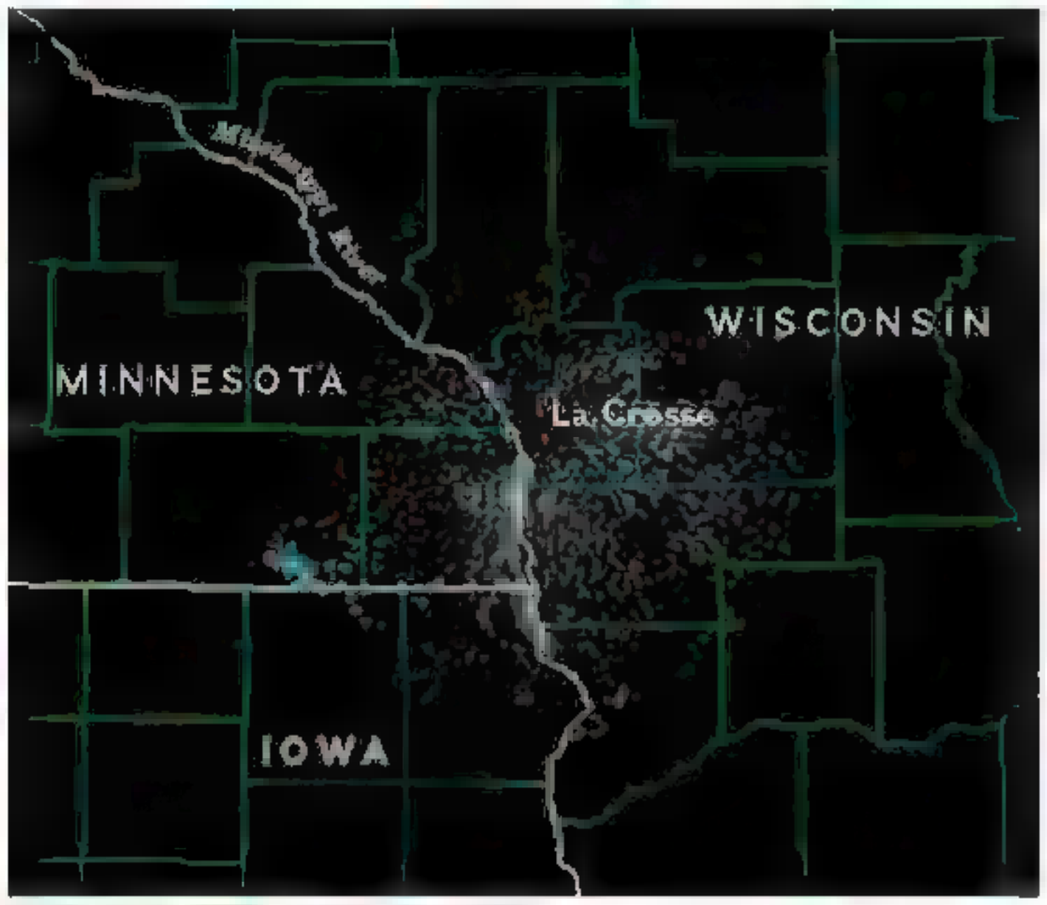
Terroir can be defined as that mystical melding of light, water, soil, air and human touch. It is a definition I often use. The simple fact is, you must have ■ world-class grape in order to make a world-class wine. And when it comes to grapes their source, the land is what matters.

Precious few places exist on this Earth that will produce grapes of this caliber. We have been fortunate to find several of those places in California's cool coastal mountains, hillsides, ridges and benchlands. It is some of the best land in California. And why you will see the Jackson Estates Grown designation proudly displayed on our labels.

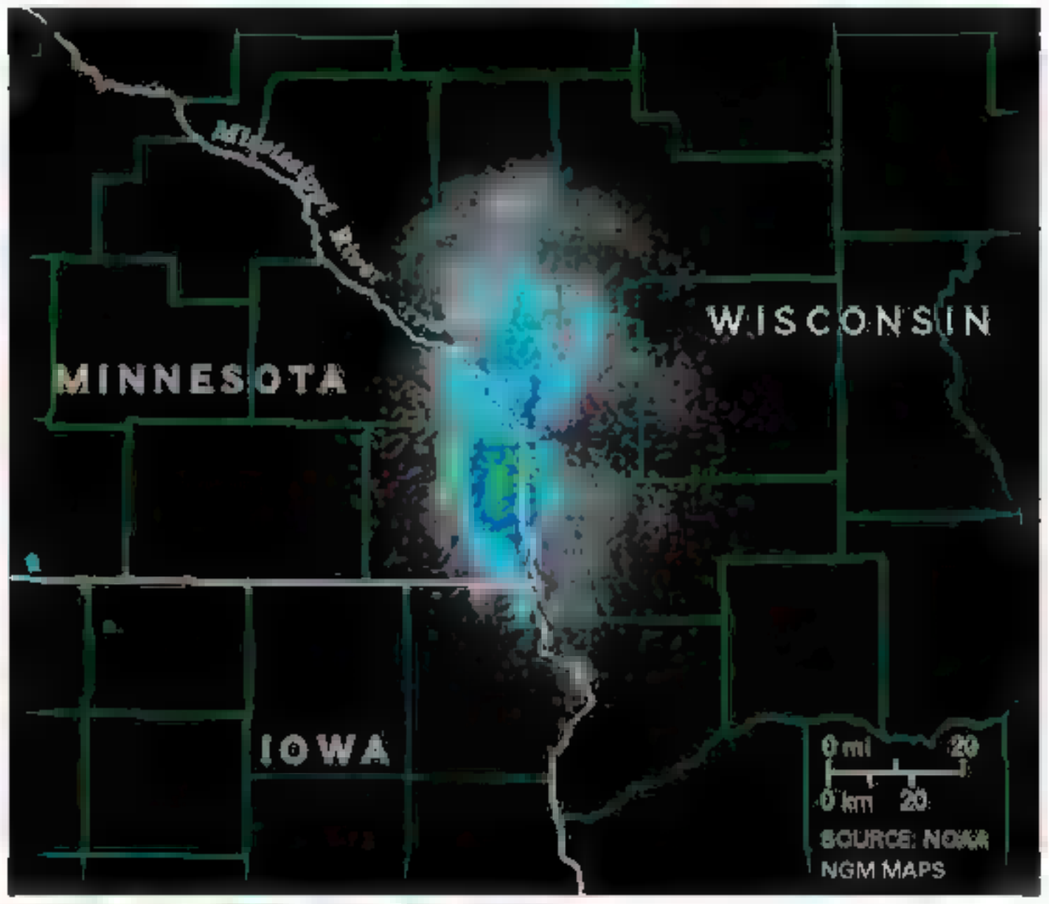
My family and I have made it our life's work to seek out these special places, have the knowledge and respect to work in concert with Mother Nature, then commit to the hard work, expense and patience to steward the wine into the bottle. It is a commitment many in our industry are either unwilling or unable to make. But we are convinced you can and will taste the difference because, ultimately, the wine's distinct personality will reflect its source, the special terroir.

I understand that many of you enjoy the taste of our wines but you aren't sure why. My goal is to help with **A Taste of the Truth.**

kj.com/truth



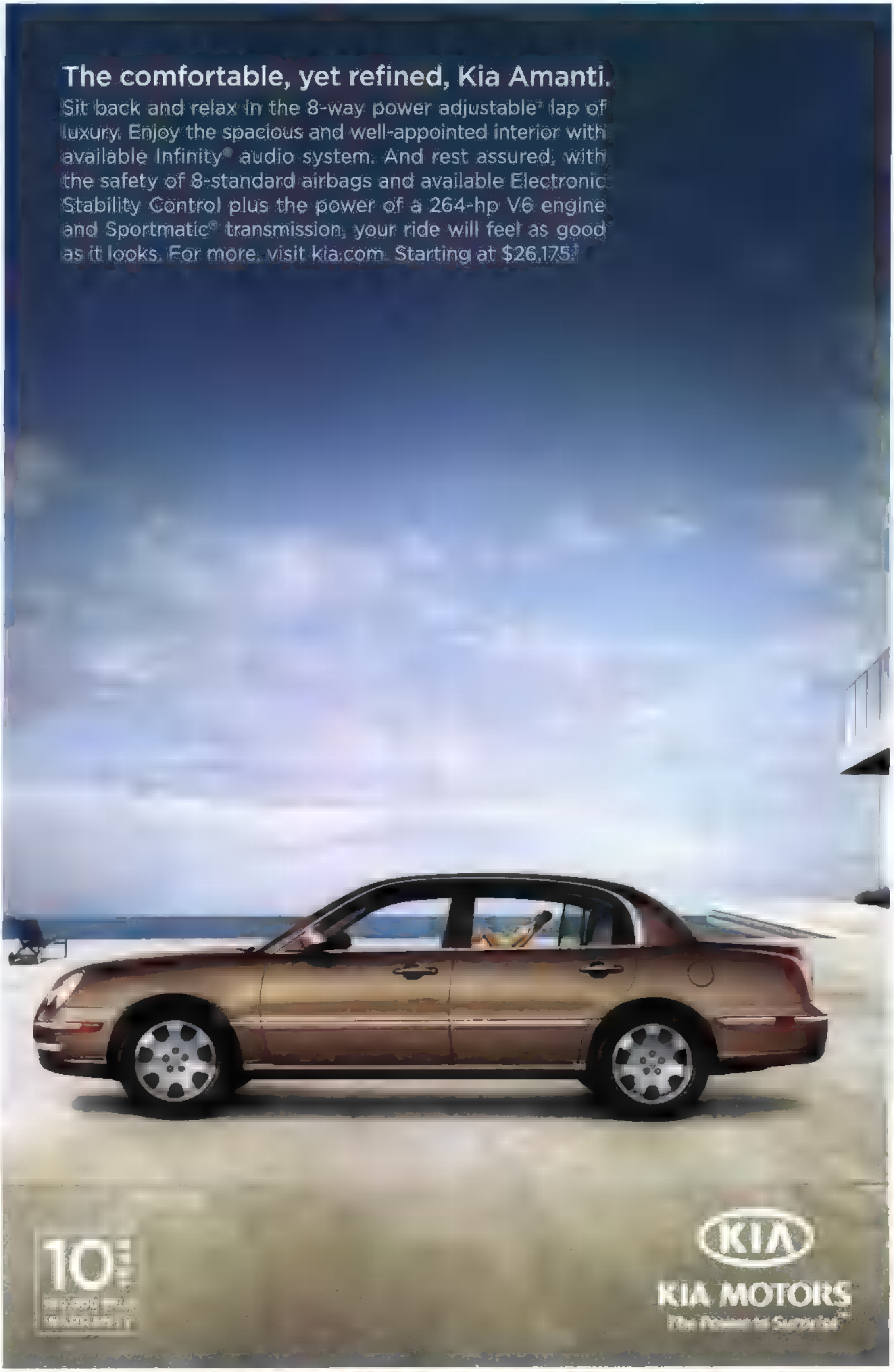
8:59 p.m. CDT, June 30, 2006



10:56 p.m. CDT, June 30, 2006

Swarmy Weather Mayflies don't emerge, they explode. Doppler radar in La Crosse, Wisconsin, picked up this insect storm along the Mississippi River: Millions of mayflies, having spent a year as wingless nymphs in the silty river bottom, rose skyward and drifted north on the wind. Map colors depict insect concentrations as decibels of energy (greens are higher than blues; gray is ground noise or just a few bugs). Bird flocks and smoke also periodically make waves on the screen, says Dan Baumgardt of the National Weather Service. "If there's no weather or wildfire in the area, it's usually biological activity." The mayfly mayhem is a good sign: They pick only the healthiest rivers as habitat. —*Jennifer S. Holland*

PHOTO: THOMAS AMES, JR.; DOPPLER IMAGES: TODD RIECK, NOAA NATIONAL WEATHER SERVICE



*Warranty is a limited powertrain warranty. †Estimated MSRP for base model is $26,175, including $660 freight, excluding taxes, title, license, options and retailer charges. Model shown with optional features costs more. Actual prices set by retailer.

NG GRANTEE **Hopping Good** When life gives you lemons, the saying goes, make lemonade. In Oaxaca, where nature gives farmers great quantities of crop-eating pests, they make toasted *chapulines*—grasshoppers freshly caught and seasoned with a bit of garlic and lime. The crunchy-legged adults and tender nymphs are also widely available in markets for about five dollars a pound. It's a considerable expense in a relatively impoverished region, and ■ strong testament to the bugs' popularity, says Jeffrey Cohen, an Ohio State University anthropologist who has begun a study of chapulín consumption with funding from National Geographic.

Cohen first tried the delicacy when offered grasshoppers in a tortilla in Oaxaca. "Slightly bitter, but tasty," he recalls. Later, his academic interest was whetted when he discovered the grasshoppers are so widely prized as a snack—popped in the mouth like popcorn—that enterprising Oaxacans are exporting them for sale to expatriates living in the United States. Though perhaps those consumers are only in the country temporarily, for as another saying—this one local—goes: If you eat a chapulín, you will always return to Oaxaca. *—Chris Carroll*

Toasted grasshoppers are a favorite at a market in Oaxaca, Mexico (top). Cooked, they turn ■ deep red (left).

PHOTOS: DANA ROMANOFF (TOP); MARK THIESSEN, NGS PHOTOGRAPHER

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What should I know about NSAIDs?

When it comes to relieving arthritis pain, you may think some prescription NSAID pain relievers, like ibuprofen and naproxen, don't have any cardiovascular risks. But based on the available research, that's not clear. And if you look closer, the FDA requires all these NSAID pain relievers, including Celebrex, to have the same cardiovascular warning.

What about heart attack or stroke?

Any prescription NSAID, including Celebrex, may increase the chance of heart attack or stroke, which can lead to death. This chance increases if you have heart disease or risk factors for it, such as high blood pressure, or when NSAIDs are taken for long periods.

How do NSAIDs affect my stomach?

All NSAIDs, including Celebrex, also increase the chance of stomach and intestine problems, such as bleeding and ulcers, which can occur without warning and may cause death. With any of these medicines, patients also taking aspirin and the elderly are at increased risk for stomach bleeding and ulcers.

What does this mean for Celebrex?

While all NSAIDs have some of the same warnings, they all treat arthritis pain. But since individual results may vary, having options is important. An NSAID, like Celebrex, may be one option. In fact, prescription Celebrex has never been taken off the market. Based on the available data, the FDA stated that for certain patients Celebrex's benefits outweigh the risks. But only you and your doctor can make that decision.

What are the benefits?

In clinical studies, a lower percentage of patients on Celebrex reported indigestion, abdominal pain and nausea versus prescription ibuprofen and naproxen. Celebrex can be used with low-dose aspirin. Other prescription NSAIDs aren't generally recommended with aspirin.

What does it do for arthritis pain?

Celebrex relieves arthritis pain, stiffness and inflammation. Just one 200 mg dose provides 24-hour relief.

Any other precautions?

Use at the lowest dose possible for the shortest time based on treatment goals. Do not take Celebrex if you're pregnant or have had allergic reactions to aspirin or sulfonamides. All NSAIDs, including Celebrex, increase the chance of serious skin reactions. And tell your doctor if you've had kidney or liver problems.

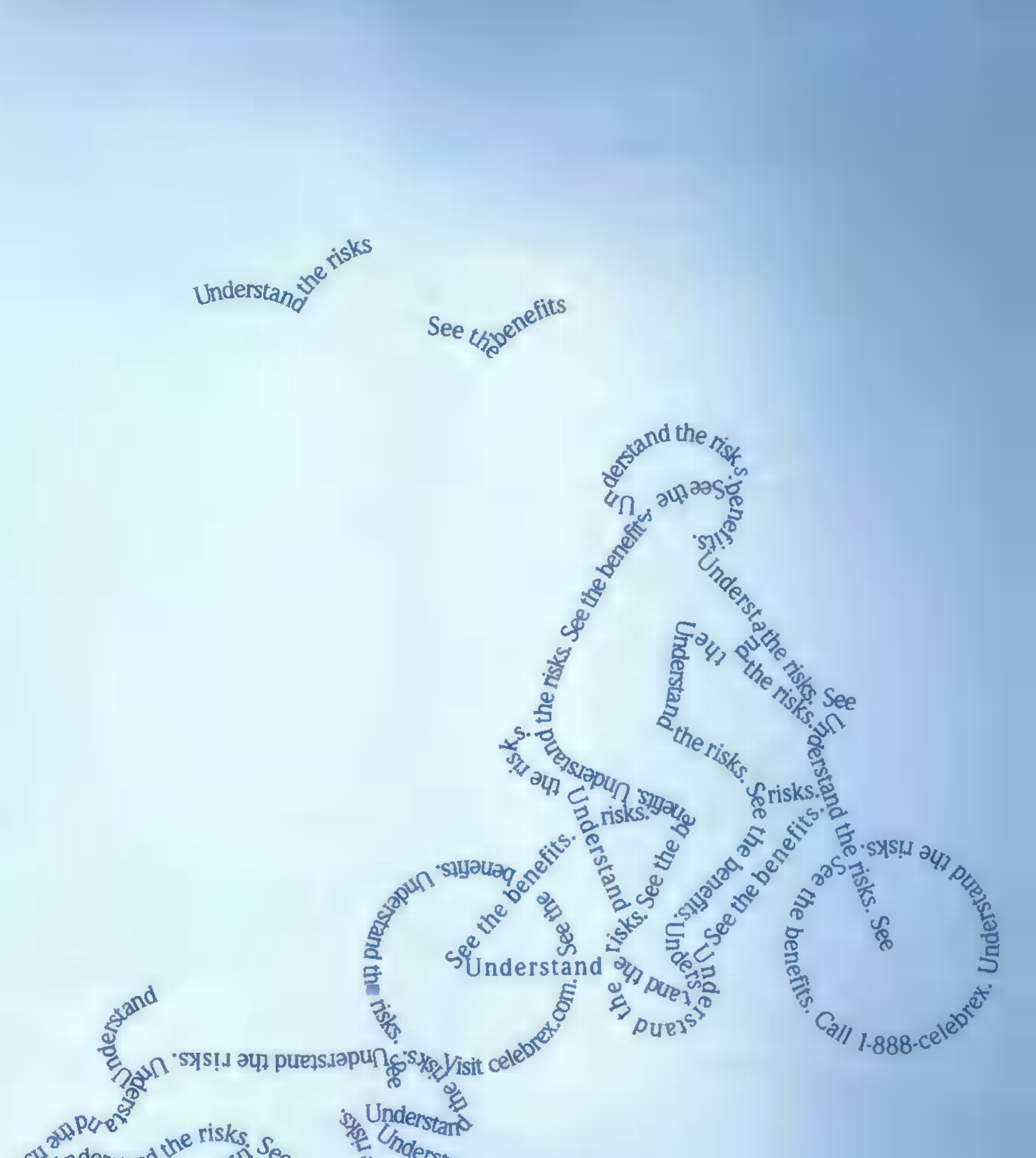
What next?

For many with arthritis pain, not treating is not an option. Talk to your doctor about Celebrex and see what's right for you.

Visit www.celebrex.com or call 1-888-celebrex. But most importantly, your doctor can tell you about the risks and benefits of all NSAID pain relievers.

Please turn page to see important information about Celebrex and other NSAIDs.

Talk to your doctor to... Understand the risks.


Understand the risks
See the benefits
Visit celebrex.com.
Call 1-888-celebrex.
CELEBREX.
(CELECOXIB CAPSULES) 100 mg 200 mg

CELEBREX®
(celecoxib capsules)

Medication Guide
for Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

(See the end of this Medication Guide for a list of prescription NSAID medicines.)

What is the most important information I should know about medicines called Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)?

NSAID medicines may increase the chance of a heart attack or stroke that can lead to death.

This chance increases:

- with longer use of NSAID medicines
- in people who have heart disease

NSAID medicines should never be used right before or after a heart surgery called a "coronary artery bypass graft (CABG)."

NSAID medicines can cause ulcers and bleeding in the stomach and intestines at any time during treatment. Ulcers and bleeding:

- can happen without warning symptoms
- may cause death

The chance of a person getting an ulcer or bleeding increases with:

- taking medicines called "corticosteroids" and "anticoagulants"
- longer use
- smoking
- drinking alcohol
- older age
- having poor health

NSAID medicines should only be used:

- exactly as prescribed
- at the lowest dose possible for your treatment
- for the shortest time needed

What are Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)?

NSAID medicines are used to treat pain and redness, swelling, and heat (inflammation) from medical conditions such as:

- different types of arthritis
- menstrual cramps and other types of short-term pain

Who should not take a Non-Steroidal Anti-Inflammatory Drug (NSAID)?

Do not take an NSAID medicine:

- if you had an asthma attack, hives, or other allergic reaction with aspirin or any other NSAID medicine
- for pain right before or after heart bypass surgery

Tell your healthcare provider:

- about all of your medical conditions.
- about all of the medicines you take. NSAIDs and some other medicines can interact with each other and cause serious side effects. **Keep a list of your medicines to show to your healthcare provider and pharmacist.**
- if you are pregnant. **NSAID medicines should not be used by pregnant women late in their pregnancy.**
- if you are breastfeeding. **Talk to your doctor.**

What are the possible side effects of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)?

Serious side effects include:

- heart attack
- stroke
- high blood pressure
- heart failure from body swelling (fluid retention)
- kidney problems including kidney failure
- bleeding and ulcers in the stomach and intestine
- low red blood cells (anemia)
- life-threatening skin reactions
- life-threatening allergic reactions
- liver problems including liver failure
- asthma attacks in people who have asthma

Other side effects include:

- stomach pain
- constipation
- diarrhea
- gas
- heartburn
- nausea
- vomiting
- dizziness

Get emergency help right away if you have any of the following symptoms:

- shortness of breath or trouble breathing
- chest pain
- weakness in one part or side of your body
- slurred speech
- swelling of the face or throat

Stop your NSAID medicine and call your healthcare provider right away if you have any of the following symptoms:

- nausea
- more tired or weaker than usual
- itching
- your skin or eyes look yellow
- stomach pain
- flu-like symptoms
- vomit blood
- there is blood in your bowel movement or it is black and sticky like tar
- skin rash or blisters with fever
- unusual weight gain
- swelling of the arms and legs, hands and feet

These are not all the side effects with NSAID medicines. Talk to your healthcare provider or pharmacist for more information about NSAID medicines.

Other information about Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

- Aspirin is an NSAID medicine but it does not increase the chance of a heart attack. Aspirin can cause bleeding in the brain, stomach, and intestines. Aspirin can also cause ulcers in the stomach and intestines.
- Some of these NSAID medicines are sold in lower doses without a prescription (over-the-counter). Talk to your healthcare provider before using over-the-counter NSAIDs for more than 10 days.

NSAID medicines that need a prescription

Generic Name	Tradename
Celecoxib	Celebrex
Diclofenac	Cataflam, Voltaren, Arthrotec (combined with misoprostol)
Diflunisal	Dolobid
Etodolac	Lodine, Lodine XL
Fenoprofen	Nalfon, Nalfon 200
Flurbiprofen	Ansaid
Ibuprofen	Motrin, Tab-Profen, Vicoprofen* (combined with hydrocodone), Combunox (combined with oxycodone)
Indomethacin	Indocin, Indocin SR, Indo-Lemmon, Indomethagan
Ketoprofen	Oruvail
Ketorolac	Toradol
Mefenamic Acid	Ponstel
Meloxicam	Mobic
Nabumetone	Relafen
Naproxen	Naprosyn, Anaprox, Anaprox DS, EC-Naproxyn, Naprelan, Naprapac (copackaged with lansoprazole)
Oxaprozin	Daypro
Piroxicam	Feldene
Sulindac	Clinoril
Tolmetin	Tolectin, Tolectin DS, Tolectin 600

*Vicoprofen contains the same dose of ibuprofen as over-the-counter (OTC) NSAIDs, and is usually used for less than 10 days to treat pain. The OTC NSAID label warns that long term continuous use may increase the risk of heart attack or stroke.

This Medication Guide has been approved by the U.S. Food and Drug Administration.

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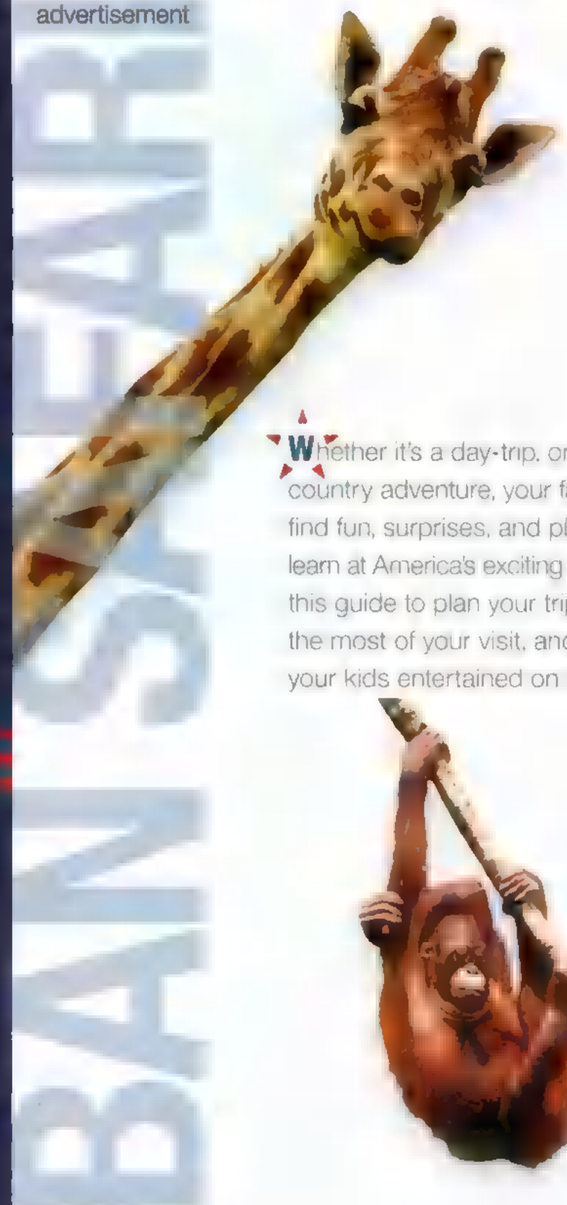
Tower of Babble

Of the world's billion Internet users, one in three logs on in English. That's no surprise. The technology got its start in the U.S., most Web pages are in English, and more than 60 percent of the U.S., Canadian, U.K., and Australian populations are online. But China is catching up. The number of Chinese speakers using the Internet is five times greater than in 2000. And with only 11 percent of the world's billion-plus Chinese speakers currently online, hundreds of millions are poised to hop on the Web. Other languages climbing rapidly are Spanish, boosted by reviving economies throughout Latin America, and Arabic, a slowly awakening market of more than a quarter billion speakers. *—Tom O'Neill*

TOP TEN LANGUAGES USED ON THE INTERNET
By number of users (millions)

PHOTO: REBECCA HALE, NGS STAFF. GRAPHIC: NGM ART. SOURCE: ENRIQUE DE ARGAEZ, INTERNETWORLDSTATS.COM



Take a Ride to America's Amazing ZOOS

Whether it's a day-trip, or a cross-country adventure, your family will find fun, surprises, and plenty to learn at America's exciting zoos. Use this guide to plan your trip, make the most of your visit, and keep your kids entertained on the way.

And to make sure you don't have to leave anything—or anyone—behind, there's the Chevy Suburban, with seating for up to nine and unsurpassed cargo capacity. From snacks for the road to picnics at the zoo, you'll have room for all the gear you need. An available DVD system between the first- and second-row seats means your kids can watch movies about their favorite animals on the way to meeting them in person. Available power-release second-row seats make it easier to enter or exit the third row no matter how many stops you make. It's no wonder that while wolves travel in packs, geese travel in flocks, and sharks travel in schools, U.S. families drive the E-85 capable* Chevy Suburban.

CHEVY

For more information visit ***chevy.com/suburban***

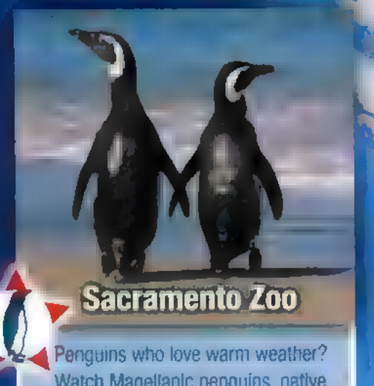
For travel directions, zoo highlights, and games visit ***nationalgeographic.com/suburbansafari***

Special thanks to

ASSOCIATION OF ZOOS & AQUARIUMS

Oregon Zoo

A rare colobus monkey is one of this zoo's newest arrivals. Born pure white from head to tail, her classic stripes will come with age. For local color, teeter across a suspension bridge into the Great Northwest exhibit, home to mountain goats, beavers, bobcats, tree-climbing black bears, soaring bald eagles, and salmon-filled streams.

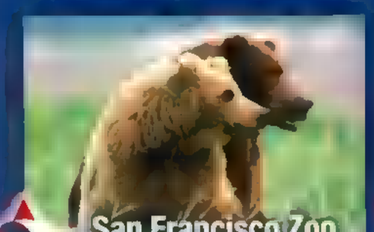


Sacramento Zoo

Penguins who love warm weather? Watch Magellanic penguins, native to Argentina and Chile, waddle, paddle, dive, and soak up California sunshine. A playful trio of rare Sumatran tiger cubs has debuted, too. And see who's getting a checkup at the zoo hospital with viewing windows for visitors.

Giant squids can produce more than a million eggs. great white sharks can have 12 babies, anacondas can have 100, American alligators can lay 60 eggs, and African wild dogs can have 21 pups in one litter!

THINK YOUR FAMILY'S BIG?



San Francisco Zoo

The zoo's newest exhibit, Grizzly Gulch, lets you journey to the rugged regions of North America where grizzly bears roam an expansive natural habitat. From your underwater-viewing vantage point, you can see them bask in a sunny meadow, cool off in a mountain stream waterfall, and even swim and fish.

Cameron Park Zoo

The lush native vegetation, waterfalls, and lakes of this natural-habitat zoo make you feel like you're strolling through a park that just happens to have exotic wild animals. Don't miss Lemur Island with its up-close viewing deck, a state-of-the-art herpetarium, and a saltwater coral reef aquarium hidden in the hull of a sunken Spanish galleon.

Louisville Zoo

See a new baby elephant snuggle with its mom; visit Lorikeet Landing where exotic birds eat nectar right from your hand; enter a forest filled with gorillas, hippos, and the culture of Africa; and explore a rare island world where every animal is an endangered or threatened species.

Cleveland Metroparks Zoo

Ready to be a shark handler? Reach in a saltwater pool and touch small sharks and the smooth skin of barbless stingrays. Swing into North America's largest collection of primate species. Travel back in time with 15 life-size roaring, robotic dinosaurs. And let a web of gardens bring the plant-animal relationship to life.

Smithsonian's National Zoo

The nation's zoo takes you to Asia on a brand-new Asia Trail. Set among waterfalls and bamboo groves, this immersive experience is filled with the sights and sounds of sloth bears, clouded leopards, a Japanese giant salamander, and of course the zoo's pride and joy, Tai Shan, a highly entertaining giant panda cub born in 2005.

Philadelphia Zoo

Prowl an amazing new exhibit filled with big cats. Come face-to-face with snow leopard cubs, puma kittens, a black jaguar cub, lions, and tigers in a lush habitat of waterfalls and pools (tigers love water!) with live training demonstrations and a wide-screen movie.

Cleveland Metroparks Zoo

Philadelphia Zoo

Smithsonian's National Zoo

Louisville Zoo

Kangaroo Conservation Center

Cameron Park Zoo

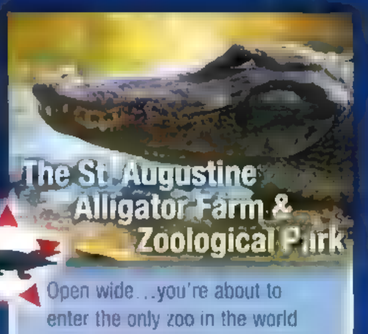
The St. Augustine Alligator Farm & Zoological Park

BEST TIPS FOR ZOO TRIPS

- Check the zoo's website for news about special events and activities.
- Arrive early—many animals are most active then and your kids will be at their freshest.
- Decide on a meeting place and a plan in case your family becomes separated.
- Vary activities—see an indoor exhibit, then an outdoor one, take a break in areas made for physical play.
- Ask the experts—zoo staff love to answer your questions.
- Attend animal presentations—check times when you arrive.
- Let your kids help write captions for photos you take at the zoo.

Kangaroo Conservation Center

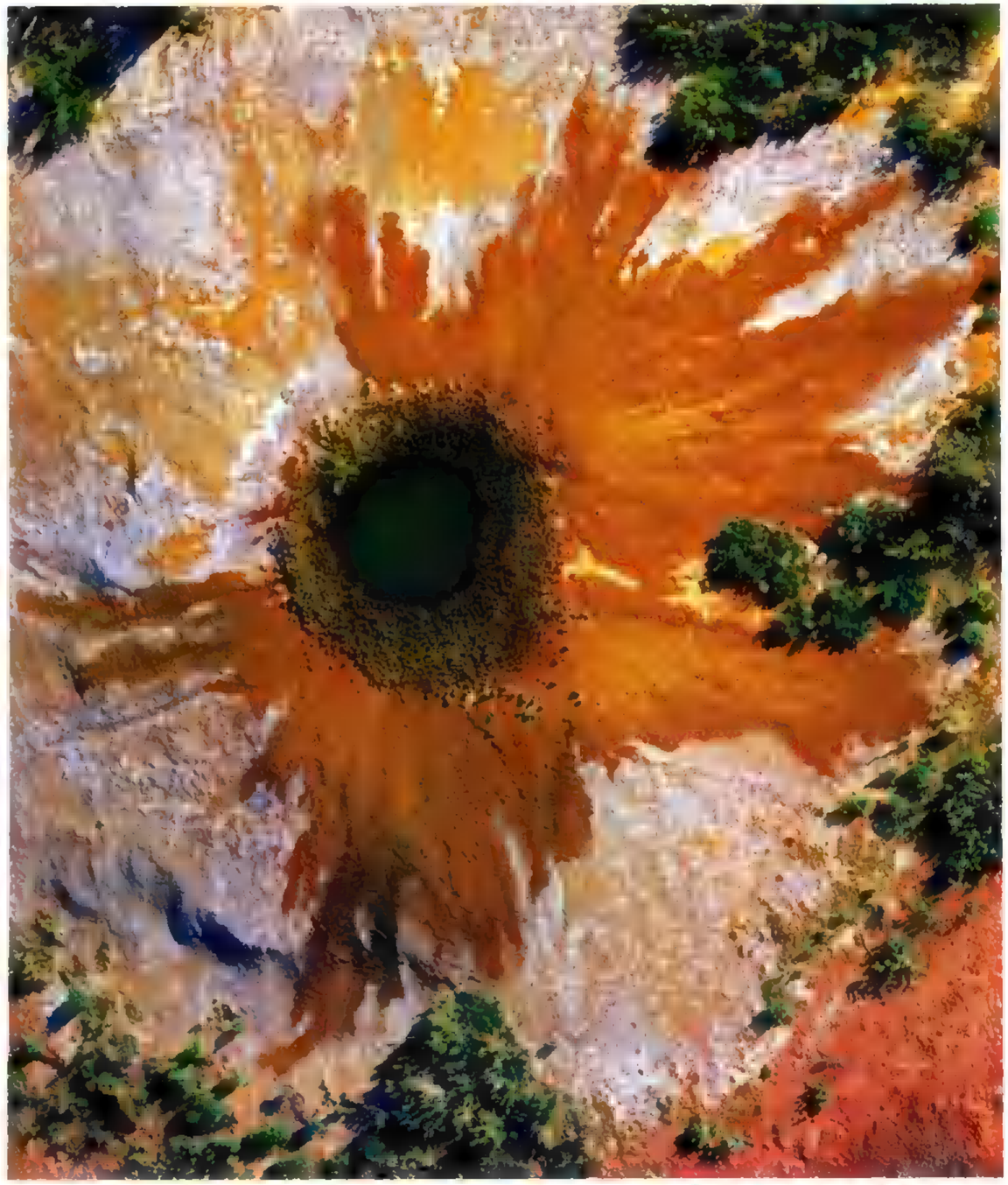
Experience the largest collection of kangaroos outside of Australia—home to eight species of marvelous marsupials. Take advantage of the educational guided tours this breeding facility and wildlife sanctuary offers to spot kangaroos, birds, and reptiles. Better bring your running shoes—kangaroos reach 55 mph at top speed, traveling 40 feet with each hop!



The St. Augustine Alligator Farm & Zoological Park

Open wide...you're about to enter the only zoo in the world with every species of crocodilian. The park's native swamp is also home to hundreds of wading birds building nests before your eyes. Other exotic residents include albino alligators, mouse-size monkeys, and a 15-foot saltwater croc weighing in at 1,250 pounds.

WHERE IN THE WORLD?



Though many hot springs dot New Mexico's volcanic Jemez Mountains, this pool's San Juan Basin source provides far cooler water.

Paint by Minerals Tepid, tinted springwater fills the heart of ■ 40-foot-high cone at the foot of the Jemez Mountains in New Mexico. Small trees inch up its travertine slopes, where years of mineral deposits have crystallized over the rust-colored ground. Says photographer Adriel Heisey, who cruised over the site in his homebuilt airplane at 300 feet, "Looking down from the plane, you sense that you're seeing what's under the skin of the Earth." *—Simran Chawla*

PHOTO: ADRIEL HEISEY

Brides Unveiled

Summer is the most popular time of year for American brides to don ■ white gown and say "I do." But in Kenya and India, November ushers in wedding season, and brilliant colors are a symbol of joy.

	SISINA	SIMRAN
Age	24	25
How They Met	The Maasai couple met as kids. Their fathers made the match and told her at her circumcision ritual, when she reached puberty.	A Sikh, she met her Hindu husband at the Mumbai advertising agency where they both work.
Wedding Dress	Glass beads adorn the cotton cloth ensemble, made by her mother and female relatives.	Six yards of silk with gold threads. The pendant and red-and-white bangles are signs of marriage.
The Night Before	Parents and family give advice on the responsibilities of marriage.	A henna artist paints designs on her hands and feet.
The Big Day	She is led to the groom's family home, where she is given ■ new name.	They hold a Sikh ceremony at 7 a.m. and a Hindu wedding at 11:30 a.m.
Traditional Gifts	The groom's family presents livestock and money to the bride's family to cement their ties.	Guests give statues of elephant-headed deity Ganesh, said to bring luck.

SISINA
Mbirikani, Kenya

SIMRAN
Mumbai, India

PHOTOS: CAROL BECKWITH AND ANGELA FISHER (LEFT); NEHA VASANT-DIDDEE

LIFE AT THE EDGE

A ringed seal escapes hungry polar bears before snatching a breath. Stealthy bears grab seals at these breathing holes

Its image mirrored in icy water, a polar bear travels submerged—a tactic often used to surprise prey. Scientists fear global warming could drive bears to extinction sometime this century.

Lagoons of meltwater cover the ice on Canada's Beaufort Sea. Over the past 30 years, Arctic sea ice has thinned as mu[illegible]cent.

Text and photographs by Paul Nicklen

On a frigid afternoon in May, I slipped through a crack in the sea ice and dropped into the Arctic Ocean. The icy water hit my face and neoprene-clad head so hard I thought I would vomit. I was diving just south of Lancaster Sound, off the northern tip of Baffin Island in the Canadian Arctic. The water was 29 degrees, about as cold as seawater gets before it freezes.

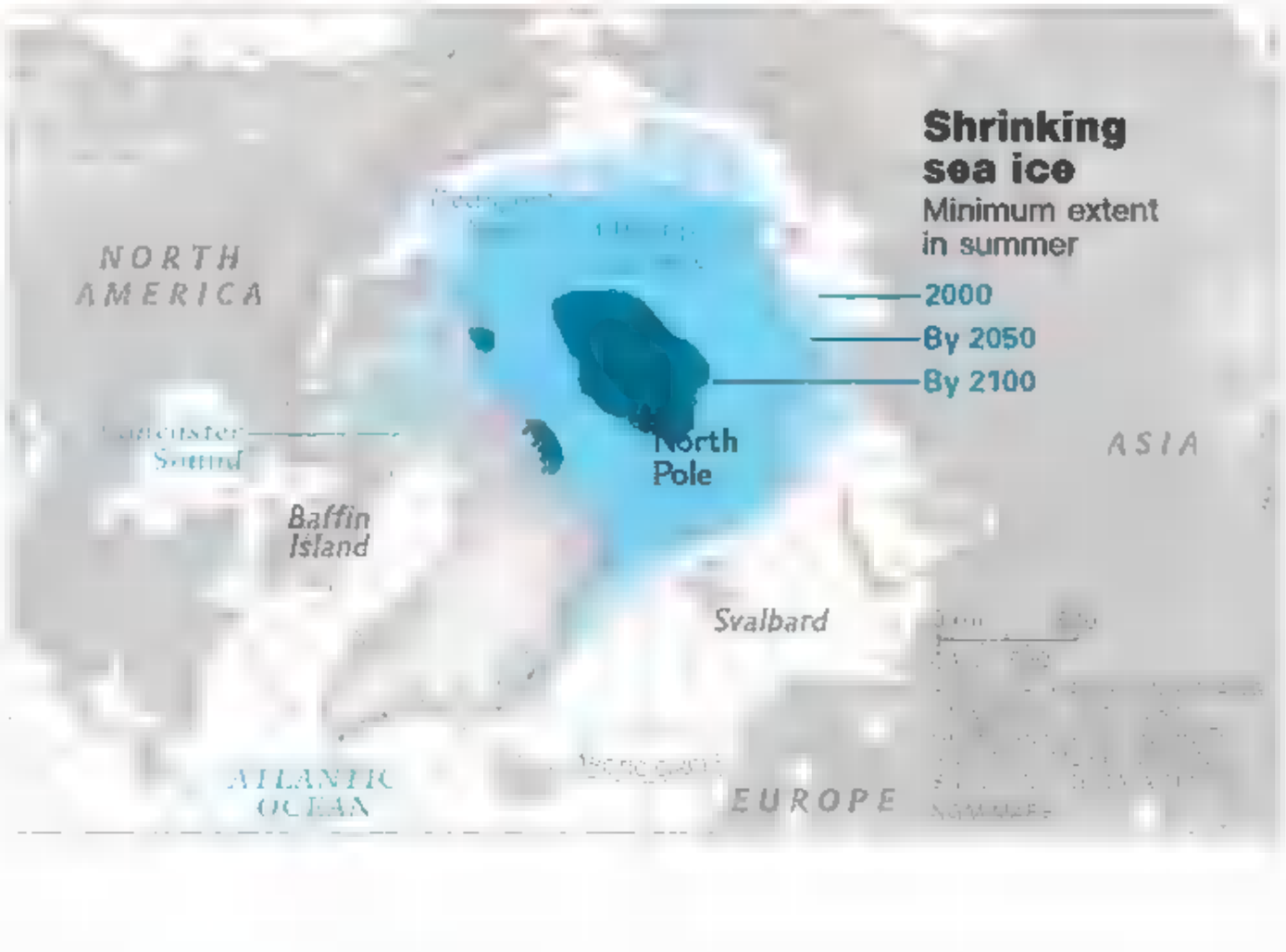
My teeth clenched the regulator as I tried to fight back nausea. Soon my breaths slowed, my head numbed to the shock, and I swam down into the blackness. At one point I looked back up at the ice, expecting it to appear as it most often does this early in the season—blue, featureless, lifeless. But something wasn't right.

The ice was stained green and brown. It moved. I blinked and checked my depth. I tried to make sure I wasn't suffering vertigo, which can be deadly to a diver working alone under the three-foot-thick roof of ice. Then it hit me: It wasn't ice at all—I was watching a massive cloud of amphipods, tiny shrimplike crustaceans, as they fed on phytoplankton that grow on the underside of the ice in spring when the sun returns to the Arctic. I was seeing the foundation of the ecosystem, the combination of ice and minute life-forms upon which all the bigger animals—polar bears, whales, birds, and seals—depend.

I've lived in the Canadian Arctic all my life and have spent most of my career photographing the edge where ice meets open sea. When I began working, sea ice seemed invulnerable: Even in the warmest months much ice remained. Ice is not just a landscape. It is part of the biology of every creature that lives in this frozen vastness. Year-round, but especially in spring, polar bears roam and hunt on the ice. Seals rest and give birth on the ice. Massive bowhead whales arrive like squadrons of submarines to feed on amphipods and copepods. Beluga whales and narwhals join them and chase arctic cod, which hide as larvae in finger-thin channels of ice. An Arctic without ice is unimaginable.

Scarcely ten years later, things have changed. The Poles are melting at an alarming rate; as global warming grinds on, the possibility of an ice-free Arctic, at least during the summer, creeps closer each day. Lancaster Sound, one of the most productive marine habitats in the world and the eastern portion of the famed Northwest Passage, may soon witness a new chapter in maritime history: The sound and areas around it may see a significant increase in shipping as the ice diminishes, bringing large freighters and tankers into a region they rarely traveled before. Some scientists even believe the Arctic will be void of summer ice, dooming species such as polar bears to extinction in less than a century. This is one of the most disturbing predictions I've heard.

The photographs here represent a decade's work. They embody my love of ice, and of the blue-white world it nourishes. The photos also carry a message, one that I understood with sudden clarity that May day as I watched amphipods flit along the ice and heard the clicks and squeaks of approaching whales: If global temperatures continue rising, the ice will likely disappear. An Arctic without ice would be like a garden without soil. —*P.N.*



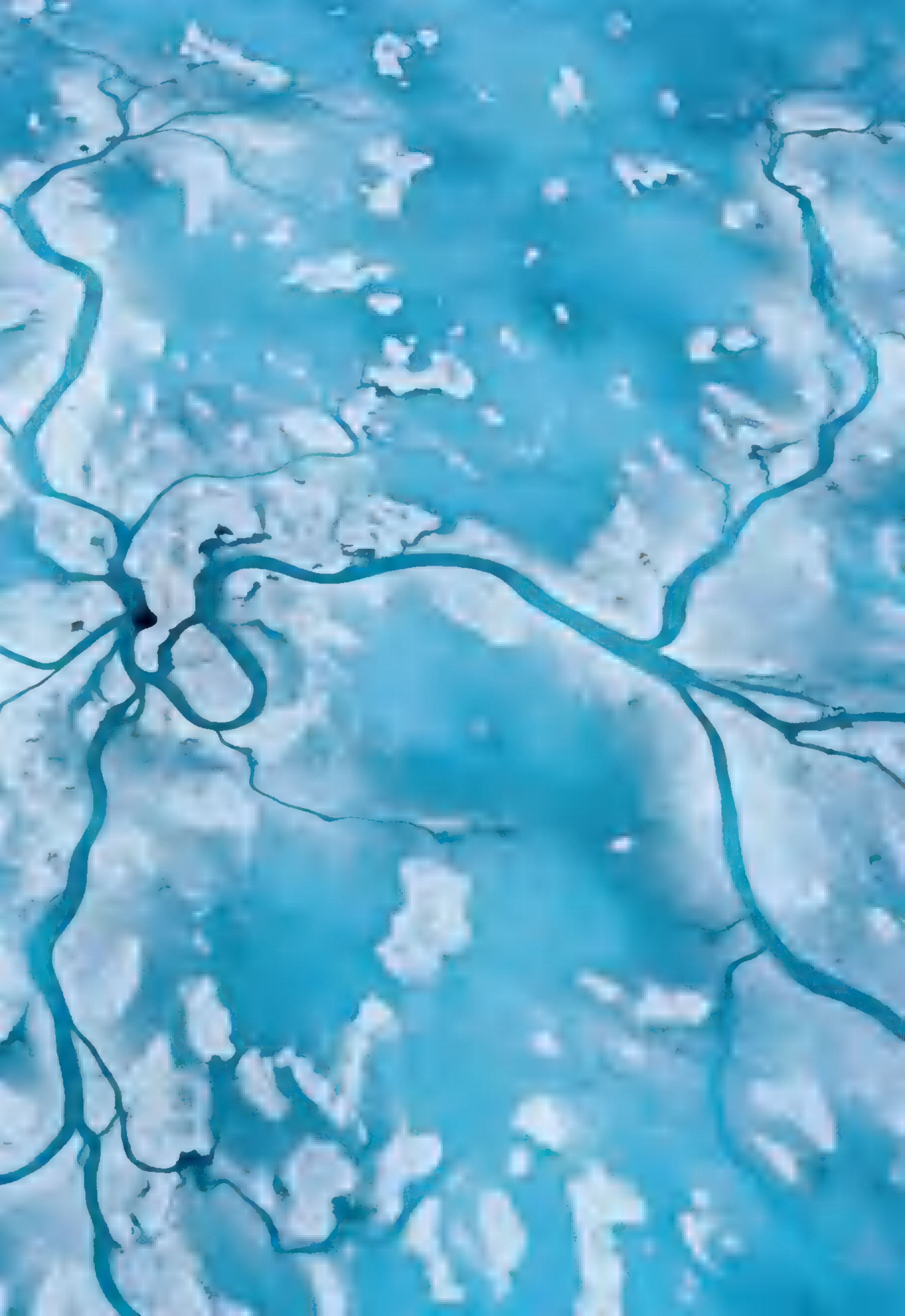
Leviathan of tusks and blubber, a bull walrus squats on a shelf of multi-year, or semipermanent, ice off Baffin Island. The extent of ice covering the Arctic Ocean in summer has diminished significantly in the past 25 years. As global warming continues, forecasters believe the ice will keep shrinking.

In some bear habitats disappearing sea ice

is already forcing bears to make longer, riskier swims.

A female bear and cub test the air on an iceberg after a swim. Not tied to specific territories, bears roam widely in search of food, often leapfrogging from berg to berg. Bears fitted with satellite collars have been tracked on long swims—up to 150 miles across open ocean. In some bear habitats disappearing sea ice is already forcing bears to make longer, riskier swims. It's rare to see dead bears on the ice, but in 2004 I found three, including one near Lancaster Sound.

Channels mel funne
breathing hole. Less eflect wa
absorbs more solar



A bowhead whale, likely scarred by sharp ice, cruises the ice edge. With life spans up to 200 years, bowheads are among the largest and longest lived animals on Earth. They were favorite targets of whalers and remain endangered today, some hundred years after hunting ceased. Bowheads feed on minute creatures such as amphipods (above), swallowing clouds of them at a time. Withering sea ice could reduce amphipod habitat and bowhead food supplies.

The possibility of an ice-free Arctic,

at least during the summer, creeps closer each day.

Like phantoms, a pair of beluga whales drift out of the blackness, squawking and burbling as they pursue cod.

Ice is part of the biology of every

creature that lives in this frozen vastness.

A gale snarls on the surface (left), but life below remains tranquil, insulated from the storm. As adults, many Arctic animals are equipped with thick jackets of fat that protect them from energy-sapping cold. Young animals, such as this ringed seal, are more vulnerable and need ice on which to rest and rewarm. The pup had become lost and was crawling along in search of an escape route into the sea. I couldn't resist carrying it to the edge of the ice.

Northern fulmars soar like jets over the dawn-streaked ice. These daredevil fliers roost high on coastal cliffs and feed in patches of open water

An Arctic without ice

would be like a garden without soil.

In a chance encounter, this bear surfaced 15 feet away, shook itself—then lunged for me. Fortunately the ice beneath it snapped, and the bear slipped back into the sea, allowing me to retreat. On another day, a bear left tracks in melting snow as it patrolled the flat, featureless icescape. When I took this photo, I couldn't help wondering how rising global temperatures may soon impact the Arctic, changing forever the ice and the animals that depend on it. □

Go Deeper Dive under the ice at **ngm.com/0706**. For more coverage of Earth's changing climate from National Geographic and NPR, visit **ngm.com/climateconnections** and **npr.org/climateconnections**.

THE BIG THAW

IT'S NO SURPRISE THAT A WARMING CLIMATE IS MELTING THE WORLD'S GLACIERS AND POLAR ICE. BUT NO ONE EXPECTED IT TO HAPPEN THIS FAST.

When meltwater surging across Greenland's ice drains to the bedrock, the ice sheet slides faster to the sea—one of many feedback processes speeding global ice loss.

By Tim Appenzeller NATIONAL GEOGRAPHIC STAFF

Photographs by James Balog

Even in better times, the Chacaltaya ski area was no competition for Aspen. Set in a bleak valley high in the Andes mountains of Bolivia, it offered a half-mile swoop downhill, a precarious ride back up on a rope tow, and coca-leaf tea for altitude headaches. At 17,250 feet, after all, Chacaltaya was the highest ski area in the world. "It gave us a lot of glory," says Walter Laguna, the president of Bolivia's mountain club. "We organized South American championships—with Chile, with Argentina, with Colombia."

The glory days are over. Skiing at this improbable spot depended on a small glacier that made a passable ski run when Bolivia's wet season dusted it with snow. The glacier was already shrinking when the ski area opened in 1939. But in the past decade, it's gone into a death spiral.

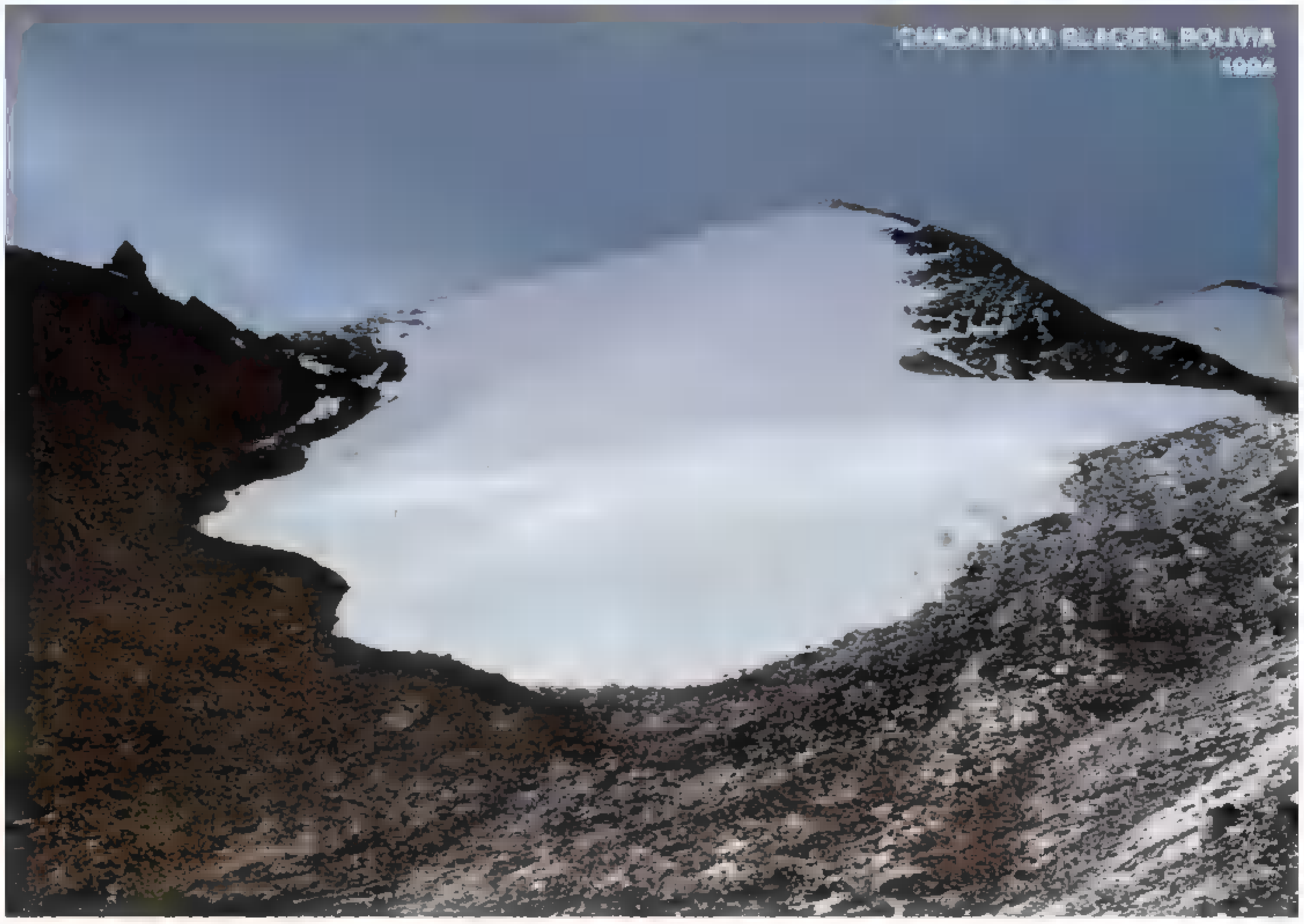
By last year all that remained were three patches of gritty ice, the largest just a couple of hundred yards across. The rope tow traversed boulder fields. Laguna insists that skiing will go on. Perhaps the club can make artificial snow, he says; perhaps it can haul in slabs of ice to mend the glacier. But in the long run, he knows, Chacaltaya is history. "The process is irreversible. Global warming will continue."

From the high mountains to the vast polar ice sheets, the world is losing its ice faster than anyone thought possible. Even scientists who had monitored Chacaltaya since 1991 thought it would hold out for a few more years. It's no surprise that glaciers are melting as emissions from cars and industry warm the climate. But lately, the ice loss has outstripped the upward creep of global temperatures.

Scientists are finding that glaciers and ice sheets are surprisingly touchy. Instead of melting steadily, like an ice cube on a summer day, they are prone to feedbacks, when melting begets more melting and the ice shrinks precipitously. At Chacaltaya, for instance, the shrinking glacier exposed dark rocks, which sped up its demise by soaking up heat from the sun. Other feedbacks are shriveling bigger mountain glaciers ahead of schedule and sending polar ice sheets slipping into the ocean.

Most glaciers in the Alps could be gone by the end of the century, Glacier National Park's namesake ice by 2030. The small glaciers sprinkled through the Andes and Himalaya have a few more decades at best. And the prognosis for the massive ice sheets covering Greenland and Antarctica? No one knows, if only because the turn for the worse has been so sudden. Eric Rignot, a scientist at NASA's Jet Propulsion Laboratory who has measured a doubling in ice loss from Greenland over the past decade, says: "We see things today that five years ago would have seemed completely impossible, extravagant, exaggerated."

The fate of many mountain glaciers is already sealed. To keep skiing alive in Bolivia, Walter Laguna will need to find a bigger, higher ice field. And the millions of people in countries like Bolivia, Peru, and India who now depend on meltwater from mountain glaciers for irrigation, drinking, and hydropower could be left high and



Years ago, says a veteran skier, "conditions were fantastic" at the world's highest ski area, on 17,250-foot Chacaltaya Glacier near La Paz, Bolivia. Today, few attempt the run, even after a snowfall. The glacier has shriveled in the past decade, turning much of the slope into a boulder field.

BERNARD FRANCOU (BOTH)

A Global Retreat

Ice is on the run in its mountain and polar strongholds. As the ice sheets on Greenland and Antarctica shrink in the next few centuries, seas could rise 20 feet. (Floating sea ice, also dwindling, does not affect sea level.) The shrinkage of mountain glaciers (chart) will dry up rivers and alter landscapes.

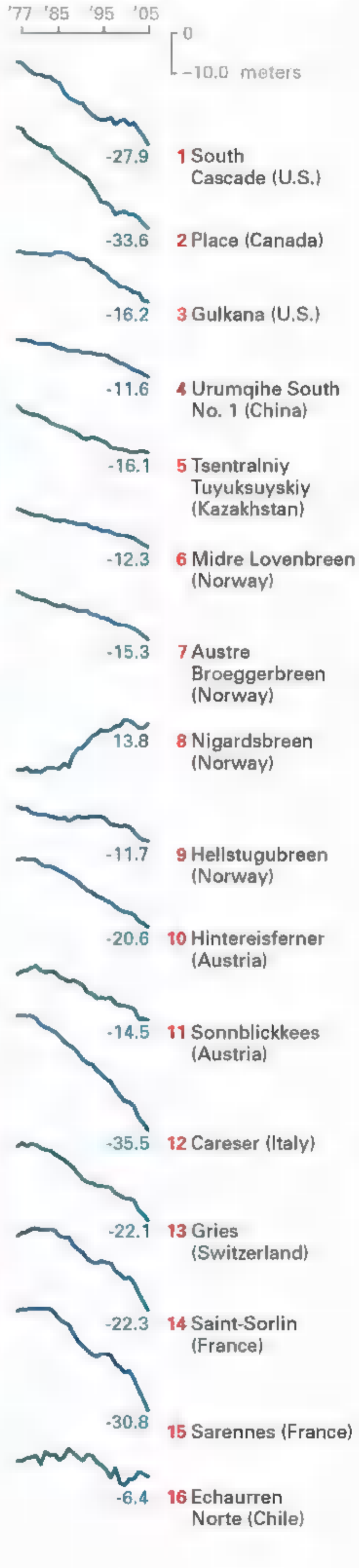
SOURCES: GLOBAL LAND ICE MEASUREMENTS FROM SPACE, NATIONAL SNOW AND ICE DATA CENTER, MICHAEL ZEMP, WORLD GLACIER MONITORING SERVICE

NGM MAPS

MOST GLACIERS LOSING ICE

Cumulative change in average thickness of glaciers in a global sample

(in meters, since 1977)



dry. Meanwhile, if global warming continues unabated, the coasts could drown. If vulnerable parts of the ice that blankets Greenland and Antarctica succumb, rising seas could flood hundreds of thousands of square miles—much of Florida, Bangladesh, the Netherlands—and displace tens of millions of people.

The temperature threshold for drastic sea-level rise is near, but many scientists think we still have time to stop short of it, by sharply cutting back consumption of climate-warming coal, oil, and gas. Few doubt, however, that another 50 years of business as usual will take us beyond a point of no return.

Ancient coral heads, white and dead, record an earlier time when the climate warmed and the seas rose. Found just inland in the Florida Keys, Bermuda, and the Bahamas, they date from roughly 130,000 years ago, before the last ice age. These corals grew just below the sea surface, and are now marooned well above it. When they flourished, sea level must have been 15 to 20 feet higher—which means that much of the water now in Greenland's ice was sloshing in the oceans.

All it took to release that water was a few degrees of warming. Climate back then had a different driver: not fossil-fuel emissions but changes in Earth's tilt in space and its path around the sun, which warmed summers in the far North by three to five degrees Celsius compared with today. At the rate the Arctic is now warming, those temperatures could be back soon—"by mid-century, no problem," says Jonathan Overpeck of the University of Arizona, who has studied the ancient climate. "There's just unbelievable warming in the Arctic. It's going much faster than anyone thought it could or would."

Computer models that forecast how ice sheets will react to the warming tend to predict a sluggish response—a few thousand years for them to melt, shrink, and catch up to the reality of a warmer world. If the models are right, rising seas are a distant threat.

Yet what is happening on the Greenland ice sheet is anything but leisurely. For the past 15 years, Konrad Steffen of the University of Colorado at Boulder has spent each spring monitoring the ice from a camp deep in the interior. Back again in the coastal village of Ilulissat last summer, the Swiss-born climate researcher, lean and weathered from wind and glacial glare, sits with colleagues in a waterfront hotel, waiting out fog that has grounded their helicopter. "Things are changing," he says. "We see it all over."

Offshore, flotillas of icebergs drift silvery in the half-light—tangible evidence of the change. Their voyage began nearby in a deep fjord, where a glacier called Jakobshavn Isbræ flows to the sea.

Ice seems rock hard when you crunch an ice cube or slip on a frozen puddle. But when piled in a great mass, ice oozes like slow, cold taffy. On Greenland, it flows outward from the heart of the ice sheet, a dome of ice the size of the Gulf of Mexico, and either peters out on land or follows fast-flowing ice streams all the way to the ocean. Four miles wide and several thousand feet thick, Jakobshavn is an icy Amazon, disgorging more ice than any other Greenland glacier.

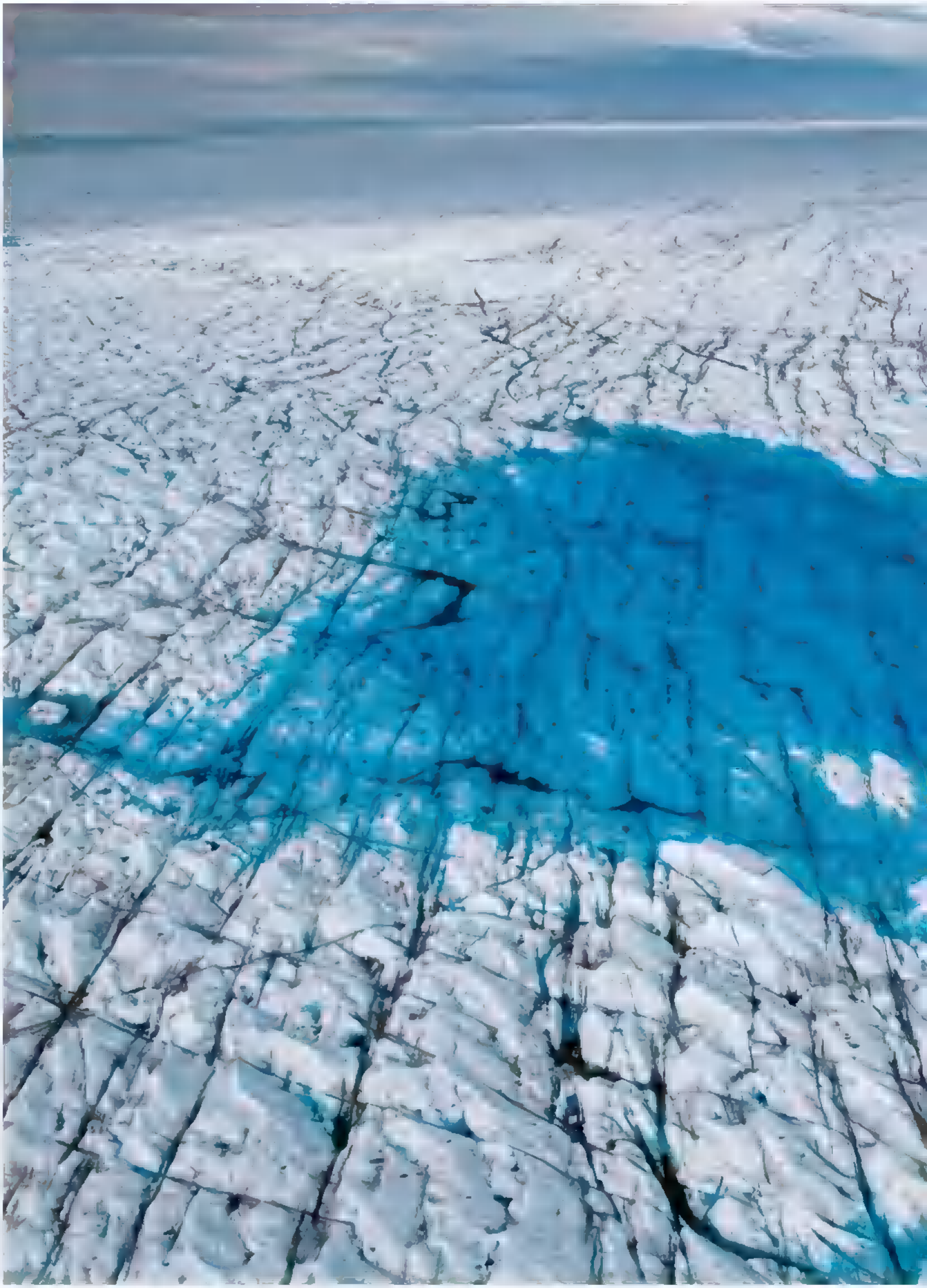
Jakobshavn is flowing ever faster. In the past decade it doubled its speed, to roughly 120 feet a day. By now it discharges 11 cubic miles of ice each year, jamming the fjord with fresh icebergs.

The pace is picking up elsewhere around Greenland. Last year Eric Rignot reported satellite radar measurements showing that most glaciers draining the southern half of the Greenland ice sheet have accelerated, some even more dramatically than Jakobshavn. He calculated that Greenland lost a total of 54 cubic miles of ice in 2005, more than twice as much as ten years ago—and more than some scientists were prepared to believe.

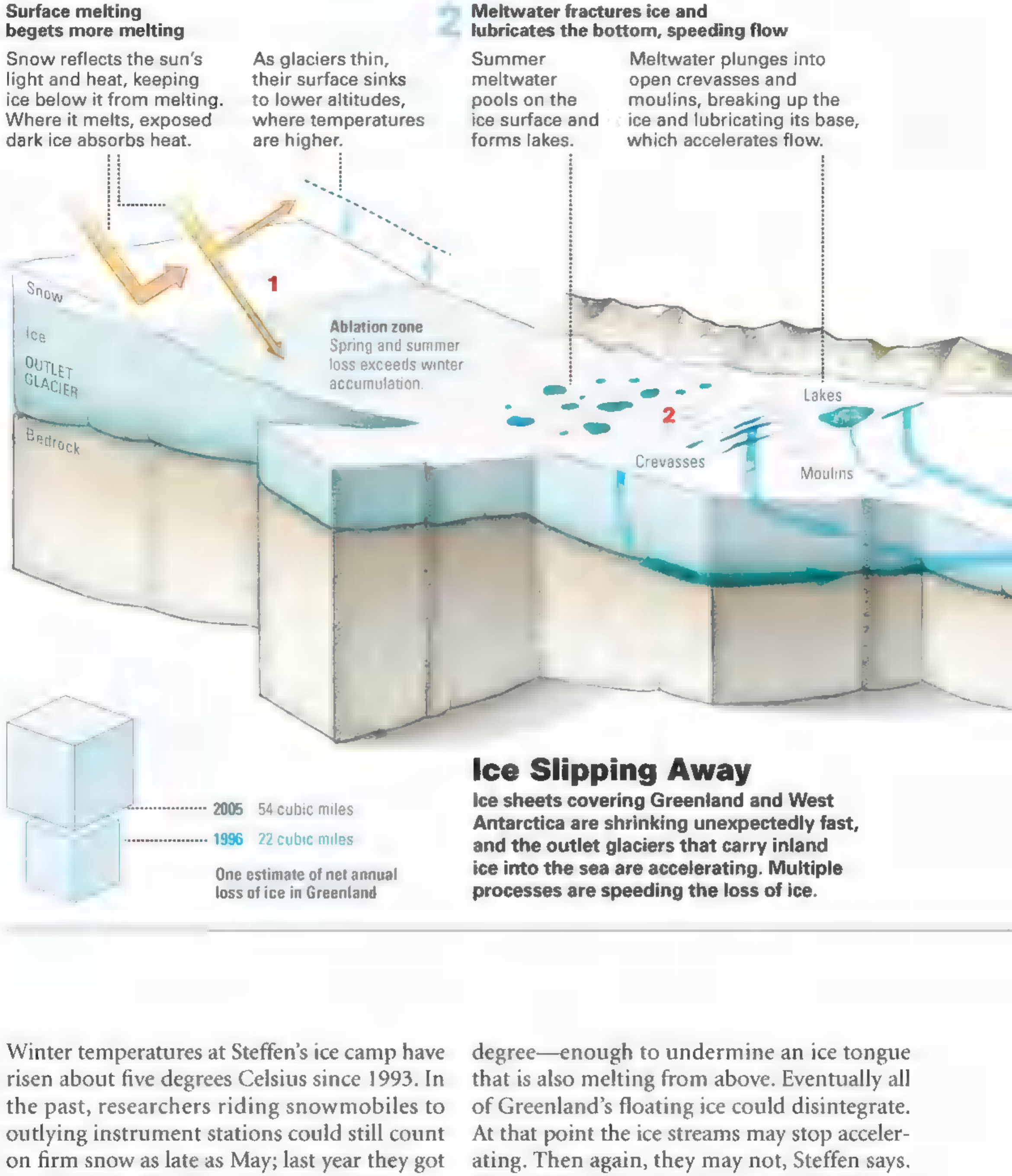
Two of the outlet glaciers have since slowed down. But other satellites detected a minuscule weakening of Greenland's gravity, confirming that it is shedding ice at a rate of tens of cubic miles a year. Says Waleed Abdalati, a NASA scientist who oversees research on Greenland and Antarctica, "The ice sheet is starting to stir."

Just as Jakobshavn accelerated, its tongue—the glacier's seaward end, floating on the waters of the fjord—began to shatter and retreat. Since 2000, the tongue has receded by four miles, adding to the clutter of icebergs in the fjord. Many of the other Greenland glaciers racing to the sea have also lost part or all of their tongues, which may explain the speedup. "Floating ice acts as a buttress," explains Abdalati. "It holds back the ice behind it, so that when it melts, it sort of uncorks the glacier."

Greenland's weather has warmed palpably.



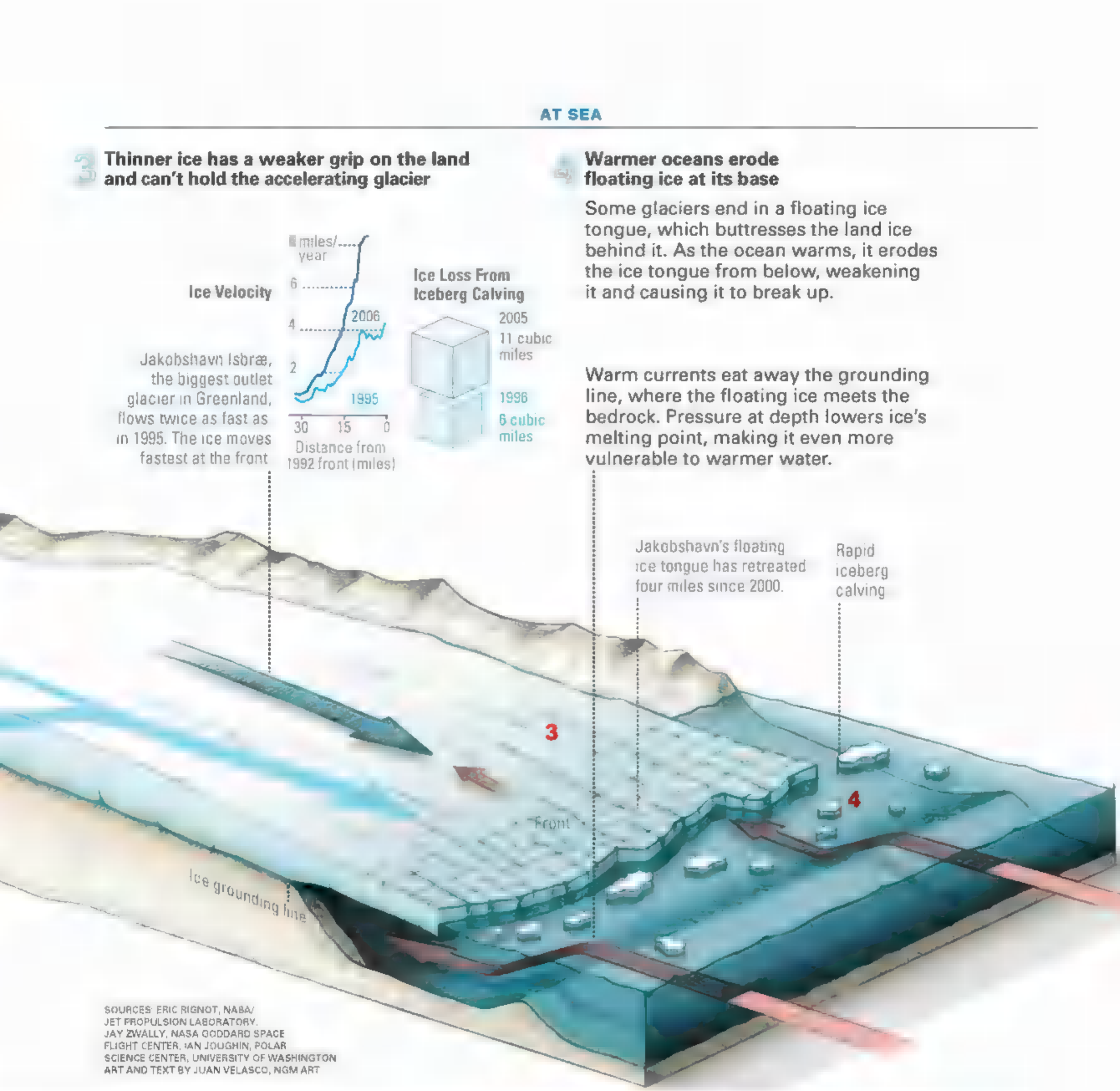

Lake of meltwater hundreds of yards wide bruises the Greenland
season getting longer, starting earlier and ending later," says resea
In the past 15 years, springtime on the ice has warmed more than



Winter temperatures at Steffen's ice camp have risen about five degrees Celsius since 1993. In the past, researchers riding snowmobiles to outlying instrument stations could still count on firm snow as late as May; last year they got stuck in slush. For the past two years Ilulissat—well above the Arctic Circle, a place where street signs mark dogsled crossings—has had long winter thaws. "It was supposed to be minus 20," says Steffen, "and instead it was raining."

Offshore, the middle depths of the Atlantic have warmed as well, by several tenths of a degree—enough to undermine an ice tongue that is also melting from above. Eventually all of Greenland's floating ice could disintegrate. At that point the ice streams may stop accelerating. Then again, they may not, Steffen says. The weight of Greenland's ice sheet has forced its bedrock down into a vast basin, much of it below sea level. As the glaciers retreat inland, the ocean may follow, prying them off their bed in a runaway process of collapse.

Right now Greenland is no threat to beachfront property. Steven Nerem of the University of



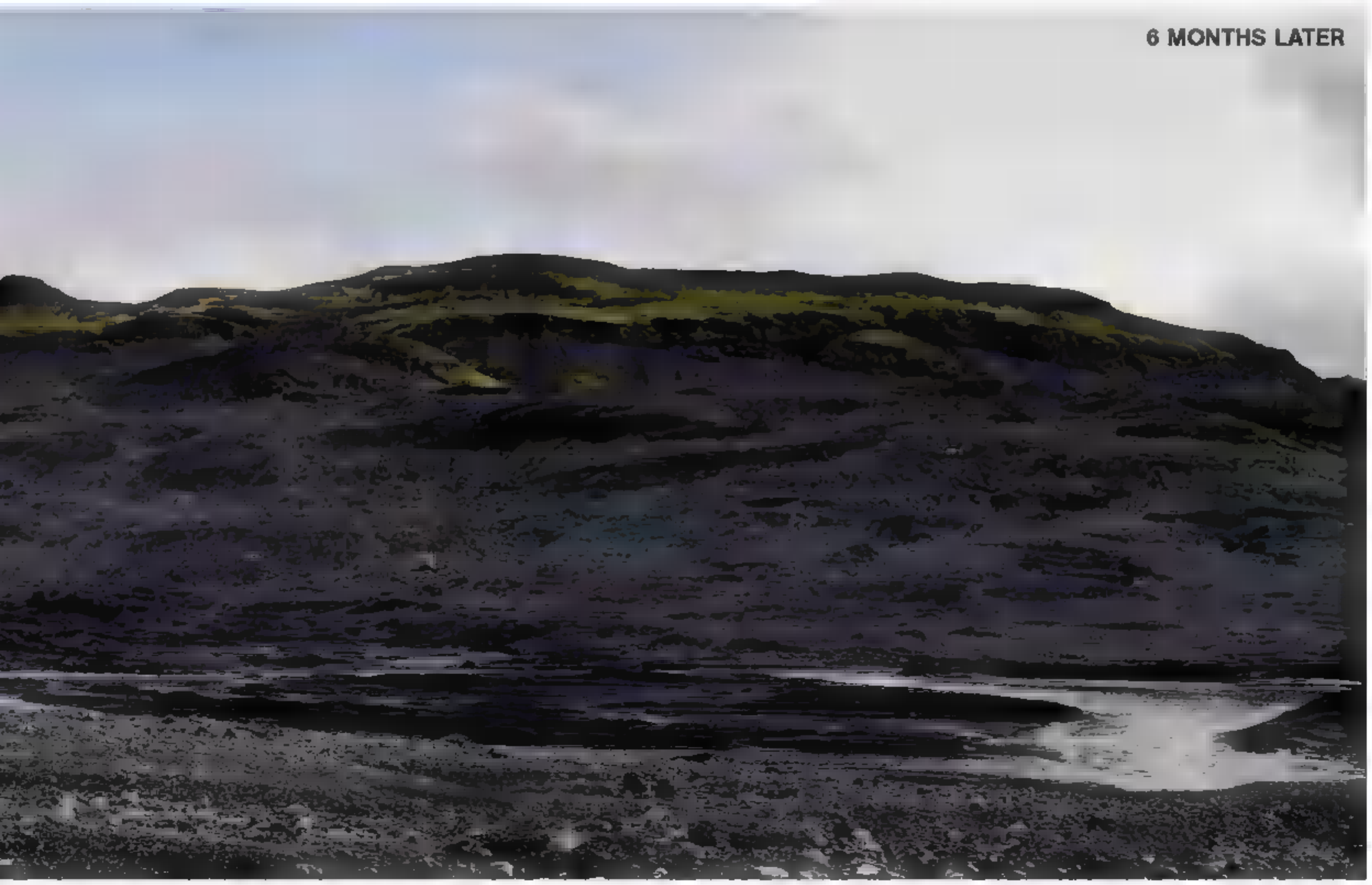
Colorado at Boulder, who monitors sea level by satellite, says the oceans have been rising an eighth of an inch a year. At that rate the sea would go up a foot by 2100, roughly what a United Nations panel on climate change predicted earlier this year. "But that's nothing compared to what we expect if Greenland really starts to go," Nerem says.

The latest signs from Greenland have persuaded many ice researchers that sea level could rise three feet by 2100. Rignot, who has measured the rush of glaciers to the sea, says even that figure may turn out to be an underestimate. Greenland, he notes, could ultimately add ten feet to global sea level, "and if this happens in the next hundred years instead of the next several hundred years, that's a very big deal."

The fog has lifted, though a drizzle lingers. The helicopter has unloaded Steffen's team onto the pitted, eroding ice sheet, about five miles in from the edge. This is the ice sheet's ablation zone, its warm, low margin, where ice from the interior comes to die. It's August, the height of the melting season. Washbasin-size

A single summer stole more than 200 feet of ice from the snout of Sólheimajökull, a glacier in Iceland, seen from the same vantage in April (top) and October 2006. The glacier has withdrawn a third of a mile over the past decade, in step with rising temperatures.


BÓLHEIMAJÖKULL, ICELAND
APRIL 2006


6 MONTHS LATER

pools of meltwater dapple the surface, and blue streams thread across the icescape.

All that water—already a loss to the ice sheet—could be causing the ice to dwindle even faster. The first hints of this feedback came ten years ago at Steffen's springtime ice camp. NASA scientist Jay Zwally set out some GPS beacons to measure how fast the ice was creeping outward from the heart of Greenland to the ablation zone. Within a couple of years an odd correlation had turned up: the more the surface melted, the faster the great pile of ice moved.

At first the effect was subtle: For a few days in high summer, the ice sped up by 10 percent over its usual pace of about a foot a day. But year by year, as the climate warmed and the melting season lengthened, the lurching increased. Zwally and Steffen proposed that the cause was meltwater pooling at the base of the ice and lubricating its contact with the bedrock. Like a car skidding on a wet road, they suggested, the ice was hydroplaning across its bed.

Somehow, water must be percolating all the way from the surface of the ice down to its base. Here and there in the ablation zone, summer melt collects in azure lakes hundreds of yards across. Sometimes, a lake vanishes from one day to the next down some invisible drain. Not far from where Steffen's helicopter touched down, a cleft in the ice, called a moulin, swallows a foaming torrent of meltwater.

Steffen, glaciologist Nicolas Cullen, and JPL engineer Alberto Behar are here to trace the plunging water. Does it plummet straight to the bottom down a chute? Does it cascade in steps? The easier the route down, the faster the ice may slide in coming years.

Behar unpacks a video camera protected in a torpedo-shaped steel housing. Before winching the camera down the moulin, the scientists rope themselves to anchors screwed into the ice and crane over the edge. The waterfall booms in the blackness, but as his eyes adjust, Steffen can make out the dimensions of the chasm. "It's the biggest moulin I've seen so far," he yells over the din. "I think it's as big as a subway station."

Lowered into the depths at the end of a fiber-optic cable, the camera drops about 350 feet, then comes to rest. In a tent set back from the drop-off, a screen shows the view from the camera: It is perched on an icy ledge, with grit-laden water rushing past. No amount of yanking on the cable frees the camera to descend any farther. Maybe it is near the base of the ice sheet—the grit could be a clue—maybe not. The scientists would like to come back for another try with a lightweight camera that might be swept along with the current.

The ice sheet's deep plumbing is still mysterious, but its effects are clearer than ever. In recent summers the ice briefly tripled its normal speed, racing faster than ever to destruction.

Look at a map, and it's easy to see why the Greenland ice sheet is so vulnerable: Its southern end is no farther north than ice-free Anchorage or Stockholm. Greenland's ice is a relic of the last ice age, surviving only because it is massive enough to make its own climate. The island's brilliant, perpetually snow-covered interior reflects light and heat. Its elevation adds to the chill, and its bulk fends off warm weather systems from farther south. As the ice sheet shrinks, all these defenses will weaken.

The bigger ice mass at the other end of the globe seems less fragile. Except for the Antarctic Peninsula, which juts past the Antarctic Circle, Antarctica is safely deep-frozen. Global warming may even be causing parts of the ice sheet to thicken, because warmer air ferries more moisture, leading to heavier snowfall. But around one remote Antarctic sea, scientists are picking up a disturbing echo of what is happening in Greenland.

The glaciers that flow into the Amundsen Sea carry ice from the heart of the West Antarctic ice sheet, the smaller of the southern continent's two ice masses. Like Greenland's ice, West Antarctica's rests on a bed that is largely below sea level. And its outlet glaciers too are stirring.

One of them, the Pine Island Glacier, a mammoth ice stream more than 20 miles wide and half a mile thick, has sped up by a third since the 1970s. Another, Thwaites Glacier, has widened, gathering ever more ice into the seaward-flowing mass. There's little agreement about how much ice West Antarctica is losing each year. But the loss could grow, eventually adding five feet or more to global sea level.

That may have happened 130,000 years ago, the last time seas rose higher than today. The sheer magnitude of the rise, 15 to 20 feet, points to a contribution from Antarctica as well as Greenland. Then, as now, Antarctica was too cold to

Greenland alone could push up sea level by three feet or so over the next century, if greenhouse warming doesn't let up.

melt from above. The attack must have come from warmer oceans that undermined floating ice, triggering a partial collapse of the ice sheet. The stage is set for it to happen again, says Robert Thomas, a glacier expert who works with NASA.

The collapse he envisions would begin at Pine Island, which ends in a floating ice shelf nearly 40 miles long. Flying over it in a Chilean Navy plane, Thomas and his colleagues found that the shelf is thinning by tens of feet a year. That explains Pine Island's speedup, says Thomas: The thinning weakens the shelf's grip on the land to either side, releasing the brakes on the glacier.

More disturbing to Thomas is the "ice plain" just inland of the floating ice shelf—15 miles of dead-flat ice, resting lightly on deep bedrock. The ice plain is also thinning, and Thomas thinks that sometime in the next decade, it will be thin enough to float free.

Once that happens and the ocean intrudes, a chain reaction of collapse could follow. "The bed is very deep and flat for the next 150 miles inland, so an enormous fjord would be created in the ice," Thomas says. "That would put the nail in the coffin—it would go on accelerating, retreating, and drain a lot of that part of West Antarctica."

Thomas won't say how fast this gloomy scenario might unfold, and some other glaciologists dismiss it. But the prospect of a sneak attack from warming oceans is worrisome enough that scientists are planning major studies for the International Polar Year, a coordinated polar research effort over the next two years. Robert Bindschadler, a NASA glaciologist, wants to drill through the Pine Island ice shelf—1,800 feet of floating ice—and lower instruments to see whether the ocean really is eroding the underside, and a British group may probe below the shelf with a robotic submarine.

Asked which of the world's great ice sheets worries him more, Greenland or Antarctica, Bindschadler just smiles and says, "Yes."

In the thin air of the Andes, doubts evaporate. Here the fate of the ice is as distinct as the jagged gray peaks around the Tuni reservoir, a major water source for Bolivia's capital, La Paz, and its burgeoning slum, El Alto.

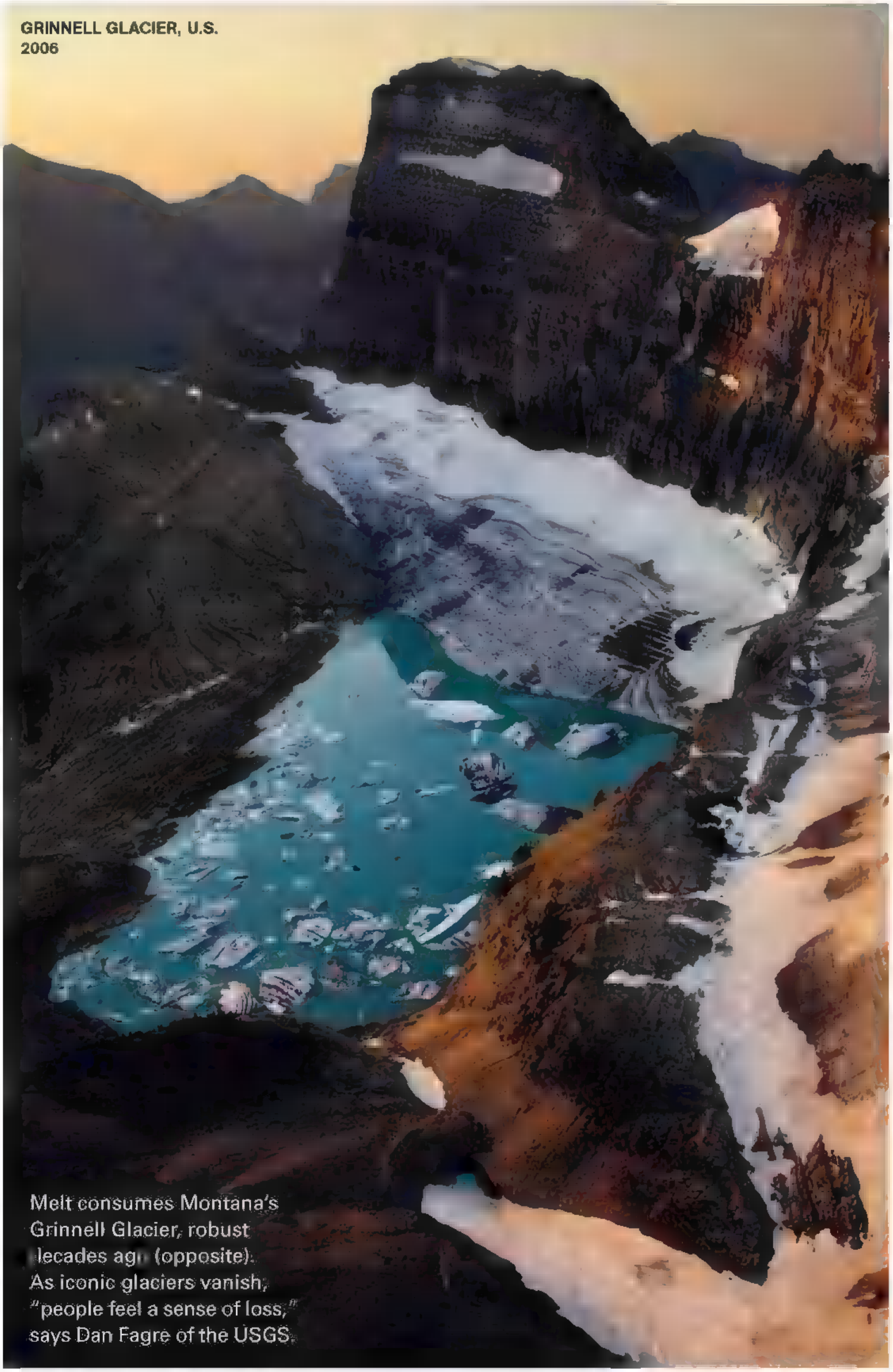
Edson Ramírez, a Bolivian glacier researcher, is on his way to check gauges along the mountain streams that fill the reservoir. He stops his truck and unfurls aerial photos of the same peaks, made in 1983. Back then, they were bearded with glaciers. Today the glaciers are shriveled, pocked —or simply gone. A point-by-point comparison shows that half of them have vanished in 20 years, and the total ice area has shrunk by 30 percent.

"In 1995, when we predicted the disappearance of the glaciers, very few people believed us," Ramírez says. "We were accused of being alarmist. But now it has come to pass." Global warming apparently struck these glaciers a roundabout blow. Every month for the past 15 years Ramírez and other scientists led by Bernard Francou, a French glaciologist, have climbed glaciers around La Paz to measure the ice and collect weather data. They saw little direct effect from the slight warming of the atmosphere in recent years. What devastated the glaciers was a relentless series of El Niños—episodes of warming in the waters of the equatorial Pacific.

El Niños, which are striking more often as the climate warms, throw global weather out of kilter, starving the tropical Andes of snow. Normally the highest part of a tropical glacier gains thickness from snowfall during the wet season, making up for melting below. But in a snowless year, glaciers gain little ice. Meanwhile, melting accelerates—because of yet another feedback.

Snow normally acts as a protective sunblock for mountain glaciers. On one of Francou's study glaciers, a two-mile-long cascade of ice called Zongo, the effect is easy to see. Zongo's upper slopes glitter with old snow, a legacy of the wet season six months ago. Reflecting the sun's light and heat, the snow keeps the ice underneath from melting. But the glacier's lower reaches are bare ice, a dull, dusty gray that absorbs solar heat like a dark T-shirt. By late morning, rivulets of melt are trickling down the ice.

An El Niño—three hit Bolivia in the 1990s—leaves most of the glacier snowless, gray, and vulnerable. Each time, the sun erodes many feet of ice, and the losses are never fully replaced. Since 1991 Zongo's surface has dropped 20 feet,



Melt consumes Montana's Grinnell Glacier, robust [illegible] decades ago (opposite). As iconic glaciers vanish, "people feel a sense of loss," says Dan Fagre of the USGS.

and the glacier's snout has retreated 650 feet upslope, leaving a lake of silty meltwater.

Zongo is a relatively healthy glacier—massive and high, topping out above 19,000 feet. Chacaltaya and the shrinking glaciers around the Tuni reservoir are smaller, lower, and more fragile. No bigger than city parks, and by far the most common kind of glacier in the Andes, they are bound for extinction in the years to come.

The loss of a ski area is sadly symbolic. But the loss of the glaciers could spell real trouble for cities like La Paz, at the receiving end of the canals and power lines that lead out of the mountains.

Mountain glaciers play a vital role as water banks, storing it as ice during wet seasons and doling it out in dry months as melt. Ramírez has found that, year-round, glacier runoff supplies about a third of the water in Tuni; in the dry season the figure rises to 60 percent. In Peru, a major hydroelectric plant and a rich agricultural valley depend on the Santa River, where 40 percent of dry-season flow is glacial meltwater. The Ganges, the lifeline for northern India, is by some estimates 70 percent glacial in the summer—runoff from Himalayan ice fields.

The bounty continues for now; in some places, it has even increased, as the glaciers melt faster than ever. But cities and farms downstream will soon feel the pinch. Edson Ramírez expects La Paz and El Alto to face water shortages before the end of the decade, as demand grows and the glacial supply starts to dwindle.

"If you dry up the mountains, what happens to the cities below?" asks Walter Vergara, a Latin America climate-change expert at the World Bank. In the developing world, the question is often asked in anger. "Climate change wasn't caused by the poor countries like Bolivia," says Oscar Paz Rada of the Bolivian Ministry of Planning and Development, "and there is a debt owed them by the developed countries."

New dams and bigger reservoirs could keep water flowing through the dry season; wind or solar power could supplement fitful hydroelectric generators. These measures won't be cheap, and some, like dams in the earthquake-prone Andes, carry risks of their own. "But time won't wait," says Paz. "People need us to take action."

Bernard Francou likes to show a whimsical photo of himself pedaling an ice-cream cart. It is his next career, he jokes, after the ice is gone. Francou is prone to dark humor. From many

T.J. HILEMAN, GLACIER NATIONAL PARK ARCHIVES

people whose lives are bound up with ice—scientists, mountaineers, ordinary people who live near the glaciers—you hear a note of mourning.

Glacier National Park in Montana is a fitting emblem for the great change sweeping the world's cold places. Dan Fagre has studied the glaciers in the park for 15 years. A scientist for the U.S. Geological Survey, he has the numbers at his fingertips: 27 glaciers left in the park out of 150 a century ago, 90 percent of the ice volume gone. He gives the remainder another 25 years. "It will be the first time in at least 7,000 years that this landscape has not had glaciers."

As a scientist, he is fascinated to watch a planet being transformed. As a human being, he feels the loss of a beloved landscape. "When I go to some of the glaciers I know well, I come over the ridge, and I don't even have to pull out maps or photos," he says. "I can just look and go, Oh my gosh, that whole area's gone." Another icy landmark, seemingly as permanent as the mountains themselves, has vanished in the heat. □

Climate Connections For more coverage of Earth's changing climate from National Geographic and NPR, visit **ngm.com/climateconnections** and **npr.org/climateconnections.** Then join a discussion in our forum at **ngm.com/0706.**

A PASSION FOR ORDER

SWEDISH BOTANIST CARL LINNAEUS TREASURED NATURE—AND GAVE US A SYSTEM FOR NAMING SPECIES STILL IN USE 300 YEARS AFTER HIS BIRTH.

Linnaeus sorted plants into 24 classes based on their sexual parts, as displayed in an artist's sketch (top) and by a *Fuchsia* blossom (left), which has eight male stamens around a female pistil.

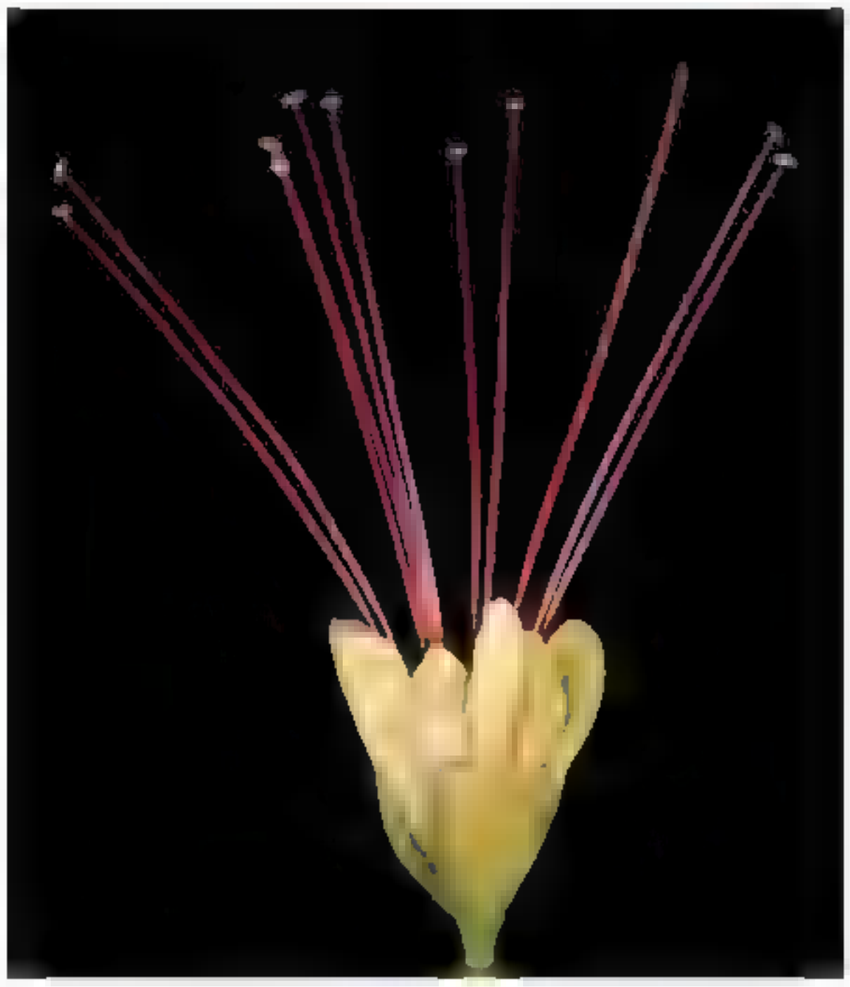
"Two men in the same marriage"

Linnaeus compared the sexual parts of each numbered class to complicated human relationships. He described class 8, for example, which included the *Fuchsia* (page 72), as "eight men in the same bridal suite with one woman." The two yellow stamens of *Salvia patens* (left), gentian sage, place it in class 2, while *Dahlia hortensis* (below), its stamens fused into a tube, belongs to class 19. Botanists now use a different system, but the bold enterprise of Linnaeus—classifying everything into groups within groups—gave a framework to modern biology.

SKETCHES BY GEORG DIONYSIUS EHRET, COURTESY THE ROYAL SWEDISH ACADEMY OF SCIENCES, STOCKHOLM UNIVERSITY LIBRARY

"The men have created a union with their sexual organs"

The thistle *Cirsium vulgare* (right), seemingly far from ■ dahlia (page 75), also falls in class 19 (above). So does the cornflower *Centaurea cyanus* (below, upper left). The narrow-leaf tulip, *Tulipa linifolia* (upper right), is one of about a hundred known members of its genus, closely related to lilies. The common comfrey (lower right), a species of *Symphytum,* is useful for glue and "effective against blood-spitting," Linnaeus wrote. The bird-of-paradise bush (lower left) takes its genus name, *Caesalpinia,* from an earlier botanist who, like Linnaeus, was also a physician.



16

"The men, like brothers, emerging from one stem"

BY DAVID QUAMMEN • PHOTOGRAPHS BY HELENE SCHMITZ

Springtime comes late in Sweden. So it was still springtime on May 23, 1707, when a son was born to the wife of the curate of a small Swedish village called Stenbrohult. The season was raw, the ground was wet, the trees were in leaf but not yet flowering as the baby arrived, raw and wet himself. The child's father, Nils Linnaeus, was an amateur botanist and an avid gardener as well as a Lutheran minister, who had concocted his own surname (a bureaucratic necessity for university enrollment, replacing his traditional patronymic, son of Ingemar) from the Swedish word *lind*, meaning linden tree. Nils Linnaeus loved plants. The child's mother, a rector's daughter named Christina, was only 18. They christened the boy Carl, and as the story comes down, filtered through mythic retrospection upon a man who became the world's preeminent botanist, they decorated his cradle with flowers.

When he was cranky as a toddler, they put a flower in his hand, which calmed him. Or anyway, again, that's what later testimony claims. Flowers were his point of entrance to appreciating beauty and diversity in nature. He seems even to have sensed, at an early age, that they were more than just beautiful and diverse—that they also encoded some sort of meaning.

He grew quickly into a boy fascinated not just by flowers, and by the plants that produce them, but also by the names of those plants. He badgered his father to identify the local wildflowers that he collected. "But he was still only a child," according to one account, "and often forgot them." His father, reaching a point of impatience, scolded little Carl, "saying that he would not tell him any more names if he continued to forget them. After that, the boy gave his whole mind to remembering them, so that he might not be deprived of his greatest pleasure." This is the sort

The genus name *Malope* (as in *Malope trifida,* right) is one of many coined by Linnaeus, who named and renamed thousands of species, bringing order to ■ chaotic body of information. Following a youthful expedition to Lapland, in 1732, he posed proudly for ■ portrait in his Lapp costume (above).

HUNT INSTITUTE FOR BOTANICAL DOCUMENTATION, CARNEGIE MELLON UNIVERSITY, PITTSBURGH

Some of Linnaeus's plant specimens (including this *Scabiosa*) are preserved at the Swedish Museum of Natural History.

of detail, like Rosebud the sled, that seems too perfectly portentous for real history, as opposed to screen drama or hagiography. Still, it might just be true. Names and their storage in memory, along with the packets of information they reference, are abiding themes of his scientific maturity. But to understand the huge renown he enjoyed during his lifetime, and his lasting significance, you need to recognize that Carl Linnaeus wasn't simply a great botanist and a prolific deviser and memorizer of names.

He was something more modern: an information architect.

If you read a thumbnail biography, in an encyclopedia or on a website, you're liable to be told that Carl Linnaeus was "the father of taxonomy"—that is, of biological classification—or that he created the Latin binomial system of naming species, still used today. Those statements are roughly accurate, but they don't convey what made the man so important to biology during his era and afterward. You might read that he coined the name *Homo sapiens* for our own species and placed us, daringly, within a category of mammals that included monkeys and apes. That's true too, but somewhat misleading. Linnaeus was no full-blown evolutionist. On the contrary, he heartily embraced the prevailing creationist view of biological origins, which stipulated that studying nature reveals evidence for the creative powers and mysterious orderliness of God. He wasn't such a pious man, though, that he sought nothing but godliness in the material world. Here's what makes him a hero for our time: He treasured the diversity of nature for its own sake, not just for its theological edification, and he hungered to embrace every possible bit of it within his own mind. He believed that humankind should discover, name, count, understand, and appreciate every kind of creature on Earth.

In order to assemble all that knowledge, two things were required: tireless and acute observation, and a system.

In spring of 1732, just before his 25th birthday, Linnaeus set off on an expedition through Lapland, the wild northern region of the Swedish kingdom, inhabited by a sparse population of the Sami people, who lived as herders of reindeer. Over the next five months he traveled some 3,000 miles, by horseback and foot and boat, making collections and taking notes as he went. He was interested in everything—birds, insects, fish, geology, the customs and technology of the Sami—but especially in plants. He made drawings in his journal, some of which were crude sketches, some of which (again, those of plants) were delicate and lovingly precise. Eventually, he produced a book, *Flora Lapponica*, describing the botanical data he had gathered.

He went abroad in 1735 to advance his career prospects. He spent three years on the Continent, mostly in Holland, taking a medical doctor's degree quickly, then turning back to plants.

It wasn't a stretch to combine both activities, since botany in that era was considered a branch of medicine, through the pharmaceutical uses

"Four men in the same marriage"

of vegetation. He found temporary work with a rich man named George Clifford, a director of the Dutch East India Company, as botanical curator and house physician at Clifford's country estate near Haarlem. Linnaeus's work there led to another book, a descriptive catalog of Clifford's botanical holdings, titled *Hortus Cliffortianus* and gorgeously illustrated by a young artist named Georg Dionysius Ehret. Although they became lifelong friends, Ehret later recalled the Linnaeus of these years as a self-aggrandizing opportunist. By any account, he was full of energy and plans, full of ideas and opinions, and hungry for success as well as for deeper knowledge. Confident to the point of arrogance but charming enough to compensate, he proved good at making friends, finding sponsors, and cultivating powerful contacts. During the three years abroad he published eight books—an amazing spurt of productivity, partly explained by the fact that he had left Sweden carrying some manuscripts written earlier. One of those manuscripts became *Systema Naturae,* now considered the founding text of modern taxonomy.

Linnaeus wasn't the first naturalist to try to roster and systematize nature. His predecessors included Aristotle (who had classified animals as "bloodless" and "blooded"), Leonhart Fuchs in the 16th century (who described 500 genera of plants, listing them in alphabetical order), the Englishman John Ray (whose *Historia Plantarum,* published in 1686, helped define the species concept), and the French botanist Joseph Pitton de Tournefort, contemporary with Ray, who sorted the plant world into roughly 700 genera, based on the appearance of their flowers, their fruit, and their other anatomical parts.

Linnaeus emerged from this tradition and went beyond it. His *Systema Naturae,* as published in 1735, was a unique and peculiar thing: a folio volume of barely more than a dozen pages, in which he outlined a classification system for all members of what he considered the three kingdoms of nature—plants, animals, and minerals. Notwithstanding the inclusion of minerals, what really mattered were his views on the kingdoms of life.

His treatment of animals, presented on one double-page spread, was organized into six major columns, each topped with a name for one of his classes: Quadrupedia, Aves, Amphibia, Pisces, Insecta, Vermes. Quadrupedia was divided into several four-limbed orders, including Anthropomorpha (mainly primates), Ferae (such as canids, felids, bears), and others. His Amphibia encompassed reptiles as well as amphibians, and his Vermes was a catchall group, containing not just worms and leeches and flukes but also slugs, sea cucumbers, starfish, barnacles, and other sea animals. He divided each order further, into genera (some with recognizable names such as Leo, Ursus, Hippopotamus, and Homo), and each genus into species. Apart from the six classes, Linnaeus also gave half a column to what he called Paradoxa, a wild-card group of chimerical or simply befuddling creatures such as the unicorn, the phoenix, the dragon, the satyr, and a certain giant tadpole (now known as *Pseudis paradoxa*) that, weirdly, shrinks during metamorphosis into a much smaller frog. Across the top of the chart ran large letters: CAROLI LINNAEI REGNUM ANIMALE. It was a provisional effort, grand in scope, integrated, but not especially original, to make sense of faunal diversity based on what was known and believed at the time. Then again, animals weren't his specialty.

Plants were. His classification of the vegetable kingdom was more innovative, more comprehensive, and more orderly. It became known as the "sexual system" because he recognized that flowers are sexual structures, and he used their male and female organs—their stamens and pistils—to characterize his groups. He defined

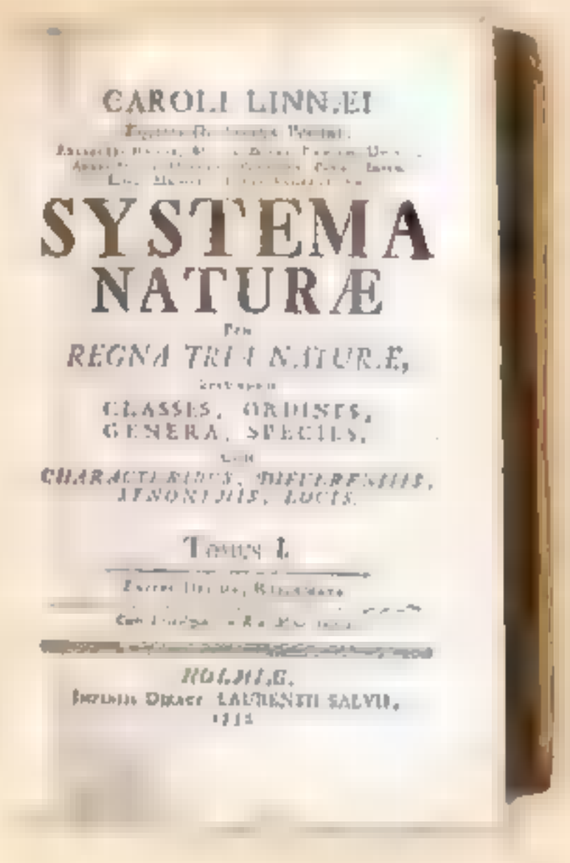
BUILDING A TREE OF LIFE

Botanist Carl Linnaeus devised a hierarchical classification system for life-forms and introduced the nomenclature still in use today. After evolution became accepted as the means by which species emerge, scientists developed family trees by analyzing the shared inheritance of specific features, such as specialized beaks and bones.

Linnaeus cataloged about

7,700 plants

4,400 animals



LINNEAN CLASSIFICATION

The tenth edition of Linnaeus's *Systema Naturae* (1758-59) marks the birth of modern taxonomy. Linnaeus used physical features to discern order in the natural world. He grouped organisms into categories called genera, which in turn were grouped into still higher categories based on similarities.

Taxonomic hierarchy

Kingdom	*Animalia*
Phylum	*Chordata*
Class	*Mammalia*
Order	*Primates*
Family	*Hominidae*
Genus	*Homo*
Species	*H. sapiens*

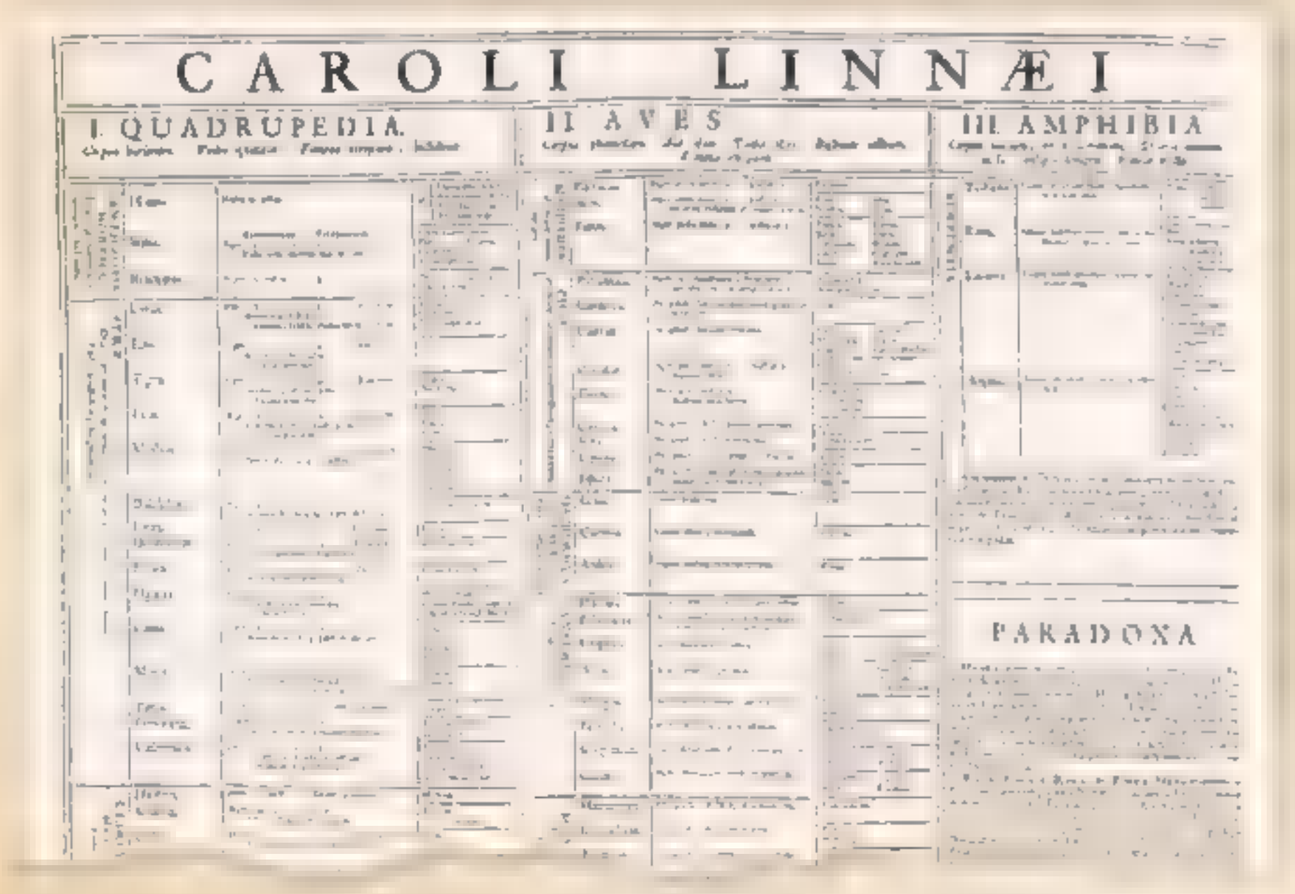
Binomial nomenclature

Linnaeus combined a genus name and a specific epithet (*sapiens*, as at right) to identify species uniquely.

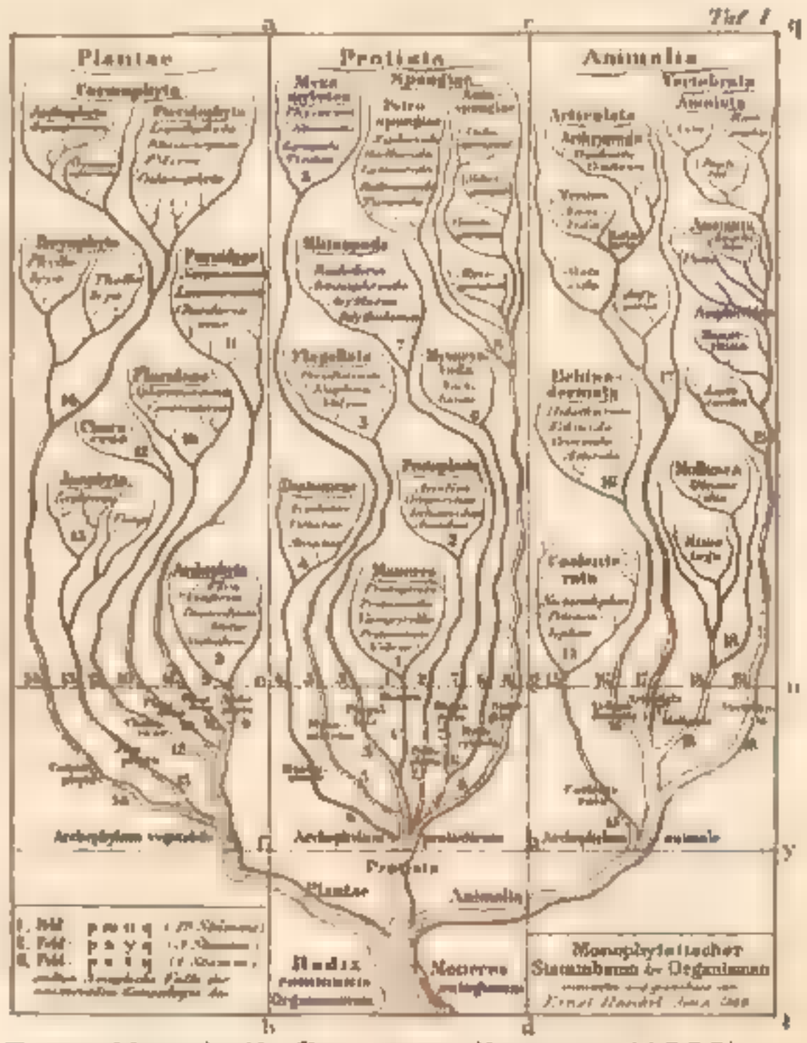
EVOLUTIONARY TREES

Building on Linnaeus's work, German biologist Ernst Haeckel (1834-1919) used the idea of a genealogical tree (bottom) to show how life-forms are related. In the mid-1900s, German entomologist Willi Hennig arranged species on evolutionary branches stemming from a common ancestor, as in the tree below.

Shaping a tree



Facsimile of the first edition of *Systema Naturae* (1735)



Ernst Haeckel's first tree diagram (1866)

COUNTERCLOCKWISE FROM TOP: ÅBO AKADEMI UNIVERSITY LIBRARY, FINLAND; ÅBO AKADEMI UNIVERSITY LIBRARY (FACSIMILE BY ROYAL SWEDISH ACADEMY OF SCIENCES); MBLWHOI LIBRARY
DESIGN AND TEXT BY JUAN VELASCO, NGM; RESEARCH BY PATRICIA HEALY. SOURCES: LINNEAN SOCIETY OF LONDON; NATIONAL SCIENCE FOUNDATION

Today, taxonomists use genetic similarities to help classify species.

Biologists estimate there are between **4** million and **100** million species on Earth.

1.75 million or more have been identified, but only

80,000 have been placed in various trees of life, and

3,000 are featured in this tree, one of the most extensive.

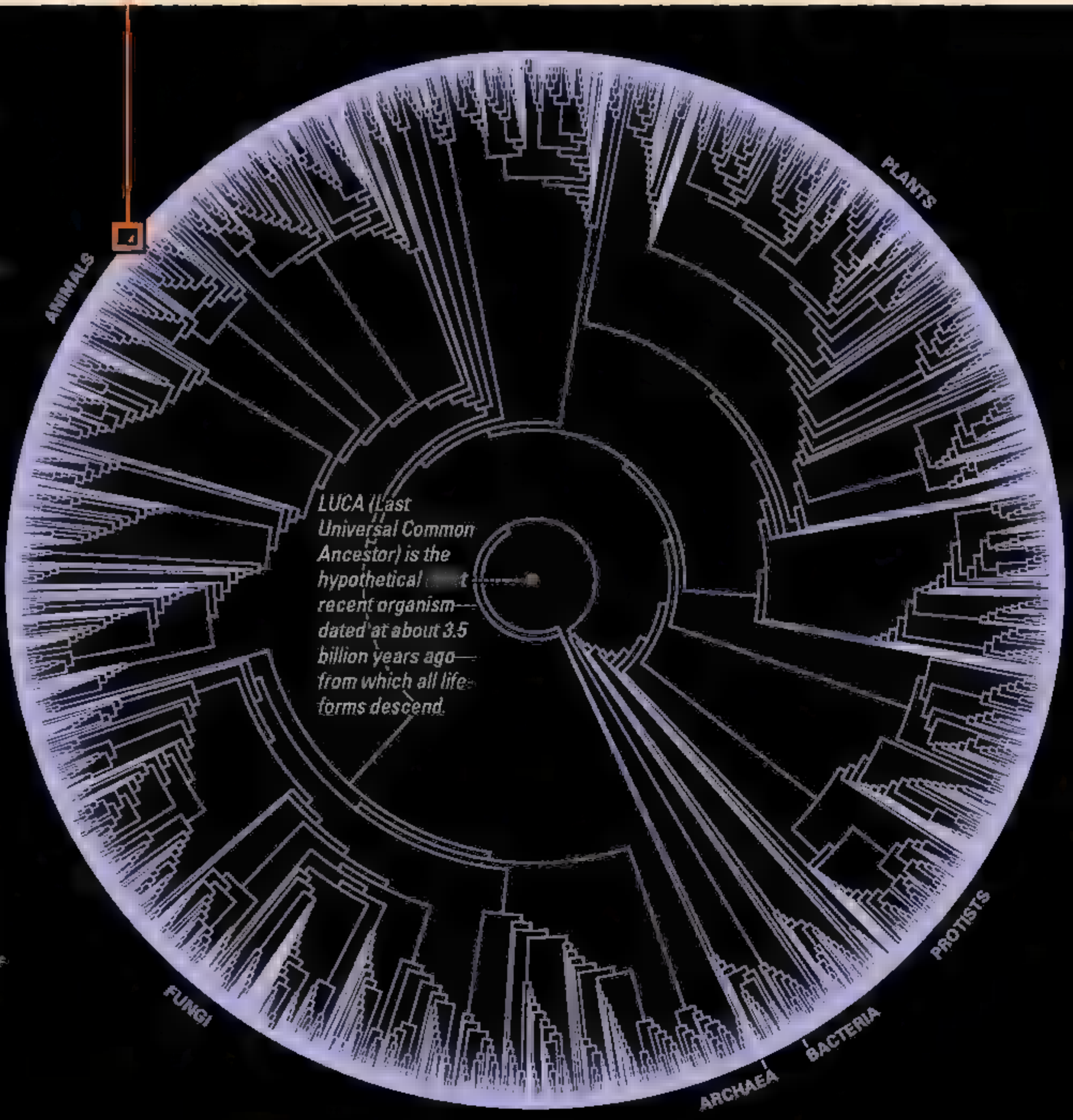
▼

GENETIC TREE

With gains in computing power allowing the creation of huge databases of genetic information, it is possible for scientists to produce more refined classifications of life-forms and their relation to common ancestors. This has confirmed some long-standing ideas and yielded some new insights.

Ongoing quest

The tree at right shows relationships, based on a single gene, among 3,000 species chosen to represent the full sweep of organisms. Many other trees are being assembled, for instance for amphibians and ferns and mosses. With its Assembling the Tree of Life Program, the National Science Foundation aims to combine current efforts into a "super tree" —a single genealogical map of all lineages on Earth.



University of Texas's **genetic tree (2003)**

DAVID M. HILLIS, DERRICK ZWICKL, AND ROBIN GUTELL, UNIVERSITY OF TEXAS AT AUSTIN

"Three men in the same marriage"

23 classes, into which he placed all the flowering plants (with a 24th class for cryptogams, those that don't flower), based on the number, size, and arrangement of their stamens. Then he broke each class into orders, based on their pistils. To the classes, he gave names such as Monandria, Diandria, Triandria (meaning: one husband, two husbands, three husbands) and, within each, ordinal names such as Monogynia, Digynia, Trigynia, thereby evoking all sorts of scandalous ménages (a plant of the Monogynia order within the Tetrandria class: one wife with four husbands) that caused lewd smirks and disapproving scowls among some of his contemporaries. Linnaeus himself seems to have enjoyed the sexy subtext. And it didn't prevent his botanical schema from becoming the accepted system of plant classification throughout Europe.

The artist Georg Ehret helped popularize Linnaeus's ideas by producing a handsome *tabella*, a poster, illustrating the diagnostic features for Linnaeus's 24 classes. The tabella sold well and earned Ehret some guldens. Linnaeus himself, always stingy about sharing credit, included Ehret's drawing without acknowledgement in one of his later books. But he wouldn't forget his old pal, and evidence left after his death—we'll come to it—suggests that he valued Ehret's botanical vision as he valued few aside from his own.

After returning to Sweden, becoming a husband and father and a professor at Uppsala University, Linnaeus continued to churn out books. He published revised and expanded editions of *Systema Naturae,* as well as strictly botanical volumes such as *Flora Suecica (Swedish Flora)* in 1745, *Philosophia Botanica* (1751), and *Species Plantarum* (1753). *Philosophia Botanica* is a compendium of terse, numbered postulates in which he lays out his botanical philosophy. For instance: "The foundation of botany is two-fold, arrangement and nomenclature." Arrangement of plants into rational categories and subcategories is crucial for three reasons: Because there are so many kinds (and more every year, during the great age of discovery in which Linnaeus lived), because much is known about many of those kinds, and because classification makes that knowledge accessible. Alphabetical listing may have worked well enough with 500 plant genera, but as the count rose into many thousands of species, it didn't serve.

There was also a deeper purpose, for Linnaeus, to this enterprise. Find the "natural method" of arranging plants into groups, and you would have discovered God's own secret logic of biological creation, just as Isaac Newton had discovered God's physical mathematics. Linnaeus knew that he hadn't achieved that, not even with his 24-class sexual system, which was convenient but artificial. He couldn't see, couldn't imagine, that the most natural classification of species reflects their degree of relatedness based on evolutionary descent. But his passion for order—for seeking a natural order—did move taxonomy toward the insights later delivered by Charles Darwin.

As for nomenclature, it contributes to the same purpose. "If you do not know the names of things, the knowledge of them is lost too," he wrote in *Philosophia Botanica.* Naming species, like arranging them, became increasingly problematic as more and more were discovered; the old-fashioned method, linking long chains of adjectives and references into fully descriptive labels, grew unwieldy. In *Species Plantarum,* he established the Latin binomial system for naming plants, and then in the tenth edition of *Systema Naturae,* published in 1758-59 as two fat volumes, he extended it to all species, both plant and animal. A pondweed clumsily known as *Potamogeton caule compresso,*

This well-preserved specimen of *Cyperus papyrus* represents one of thousands of species named by Linnaeus himself.

folio Graminis canini, et cetera, became *Potamogeton compressum.* We became *Homo sapiens.*

His life back in Uppsala entailed more than authorship. He was a wonderful teacher, with a vivid speaking style, clear and witty, and a terrific memory for facts. His lectures often packed the hall, his private tutoring earned him extra money, and he made botany both empirical and fun by leading big festive field trips into the countryside on summer Saturdays, complete with picnic lunches, banners and kettledrums, and a bugle sounding whenever someone found a rare plant. He had the instincts of an impresario. But he was also quietly effective in mentoring the most talented and serious of his students, of whom more than a dozen went off on adventuresome natural history explorations around the world, faithfully sending data and specimens back to the old man. With his typically sublime absence of modesty, he called those travelers the "apostles." In 1761, the government ennobled him, whereupon he upgraded his linden-tree name to von Linné. By then he was the most famous naturalist in Europe.

His wife sternly guarded their privacy, and his son became only a middling botanist, but his teaching role delivered rich satisfactions, and he had an abundance of brilliant intellectual offspring. Despite the limitations of his language skills (he may have known some Dutch and German but did all his writing in Swedish and Latin) and of his geographical experience (he never left Sweden again), he became a global encyclopedist of flora and fauna; in lieu of personal travel, he relied on written correspondence with naturalists all over the world and on information received from the apostles, such as Daniel Solander (who sailed on Cook's first voyage), Pehr Kalm (in North America), and Anders Sparrman (China, South Africa, then Cook's second voyage). Linnaeus himself had no appetite for the rigors and climate of the tropics, though he was voraciously curious about tropical plant diversity. Let the young men gather the information; he would systematize it.

In Uppsala, I discussed this manipulative, homebody aspect with Professor Carl-Olof Jacobson, a retired zoologist who serves as chairman of the Swedish Linnaeus Society. No, Linnaeus didn't want to travel abroad, Professor Jacobson told me. "What he wanted to be was a spider in the net."

The center of that net, that vast web of scientific silk, was in and around Uppsala—including the university, its splendid botanical garden, and a small farm known as Hammarby, about five miles outside the city. Linnaeus bought Hammarby and built a large, simple house there to be his summer retreat. It might have served also as his retirement home, though he never retired. Each autumn, having savored his time in this getaway, he moved back into town, where the living was less austere. He grew feeble and ill, then suffered a seizure after one last escape to the countryside, strictly against doctor's orders, and died on January 10, 1778. They buried him

SWEDISH MUSEUM OF NATURAL HISTORY

"Men and wives and unwed cohabit in separate bridal suites"

beneath the stone floor of Uppsala's cathedral, the Westminster Abbey of Sweden.

Six years later, following Linnaeus's posthumous instructions, his widow sold his library, his manuscripts, and most of his collections to a buyer who would care for them well. That buyer, a young Englishman named James Edward Smith, founded a scientific society to receive the treasures and called it the Linnean Society of London (its spelling derived not from his original name but from the noble version, von Linné), where they lie protected in a basement vault but available in physical (and, soon, digitized) form to scholars. Linnaeus himself would approve; knowledge, he believed, is meant to be communicated and used.

Linnaeus's country home, Hammarby, remained in the family for a century and then was bought by the Swedish state to be made a museum. Although his house near the university in Uppsala has also been saved, and lately restored, Hammarby conveys a more vivid sense of his character, his foibles, his loneliest joys. Inside the old farmhouse, overlooking muddy crop fields, his collection of walking sticks is on display. So is the red skullcap he often wore over his short-cropped hair, in lieu of a formal wig. There are portraits of his four daughters, his son, and his pet monkey, in no particular order of fondness. His wife and he kept separate bedrooms at opposite ends of the second floor. His is tucked away, accessible only through another room that functioned as his study.

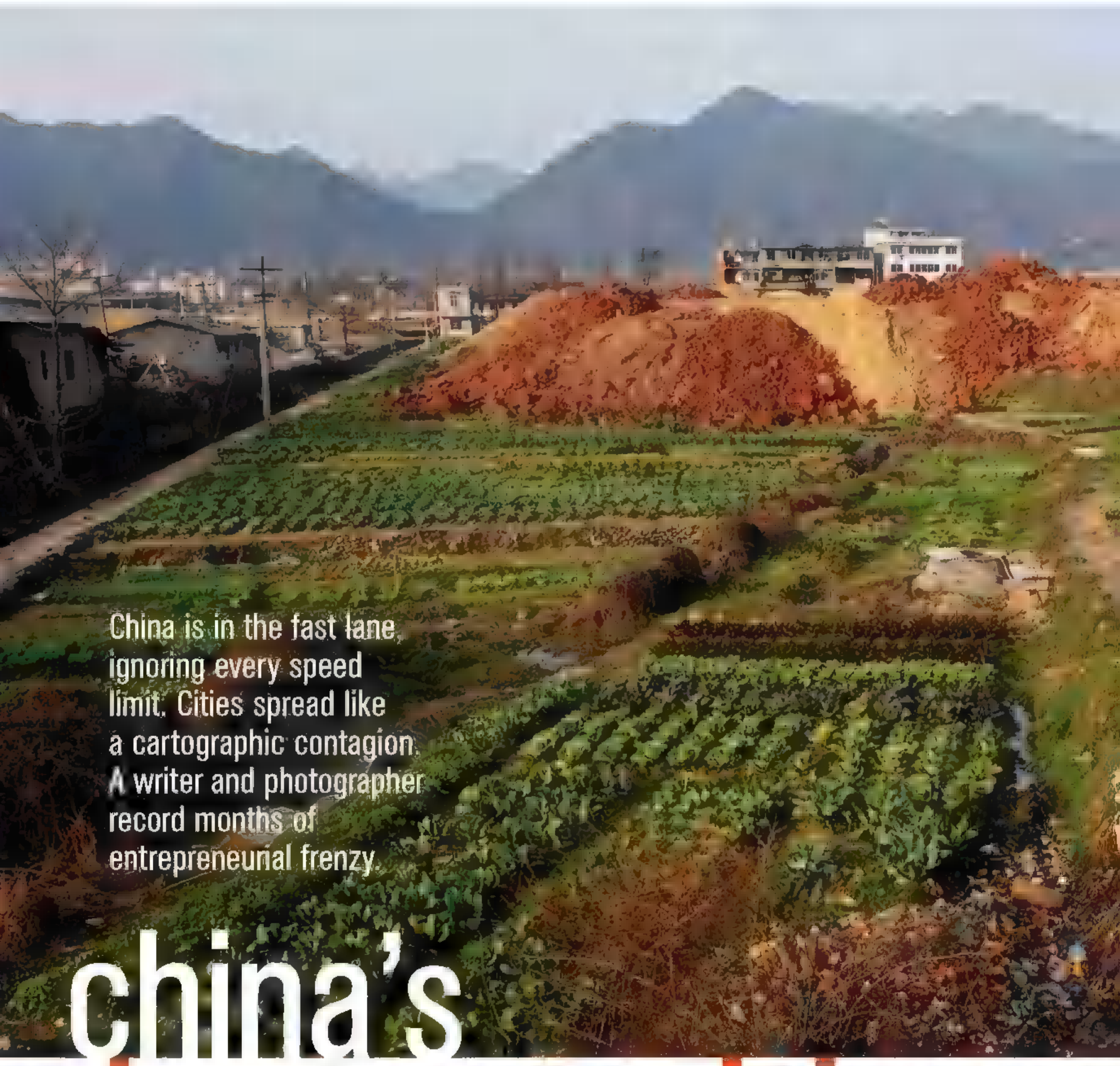
The bedroom, preserved much as he left it, contains a small curtained bed of the sort known in Sweden as a *himmelssäng*, a bed of heaven. Against the west wall is a wooden desk and, above it, a window. The walls are covered with flowers. That is, they are wallpapered wildly from floor to ceiling with large floral images cut from books. The plants are robust, exuberant, some of them garish, some elegant, all suggesting fecundity and fruition: pineapple, banana, magnolia, lily, cactus, papaya, frangipani, and others. Many of these hand-colored engravings came from paintings by his old friend Georg Dionysius Ehret. Rare and magnificent, they would be collectibles in their own right, even absent the association with Linnaeus. But, once bright and crisp, they are now faded, smeary, streaked with the punishments of moisture and time. On the day I visited, accompanied by a botanical curator named Karin Martinsson, still another damp January chill hung in the air.

Linnaeus was warned that such damage would occur, but evidently he didn't care. He wanted the pictures around him. Never mind if they decayed. So what? His own body was doing that too.

Even now these antique prints could be peeled carefully off, Martinsson told me, and preserved under better conditions. But that's not going to happen. "Taking them down from the walls," she said, "would be like ripping the heart out of Hammarby." Left as is, the heart of the house reflects the heart of its original owner: full of plants. The pilgrims who visit this room during the tercentenary year—presumably there will be many, from around the world—can look at that improvised wallpaper and sense an important truth about the lifework of Carl Linnaeus. It wasn't just about knowledge. It was about knowledge and love. □

Botanical Bite Photographer Helene Schmitz describes being "attacked" by stinging nettles in Field Notes at **ngm.com/0706**.

Musa textilis (right) is ■ Philippine banana plant. Its mixture of unisexual and bisexual flowers places it, with the many other banana species, in class 23: Polygamia (above).



china's instant cities

by Peter Hessler photographs by Mark Leong

Watered by a flood of capital, tended by migrant workers, and soon to be harvested by affluent buyers, homes shoot up in the King Dragon Villa complex in Lishui, one midsize town flourishing in the hothouse climate of Chinese urban development. Farmland is being swallowed up (left).


BUSY ZOO
BUSY ZOO
BUSY ZOO
BUSY ZOO

Out go Busy Zoo Activity Centers, assembled in a Lishui factory in the southeast province of Zhejiang and destined for sale worldwide. In come people looking for jobs. Following a brother to Lishui, Wang Hai brings his mother and his brother's wife and kids from Guizhou Province, a 30-hour train ride away.

Business plan for Yashun company: 1) Find suitable products—bra rings (bottom) and underwire. 2) Pick city with new development zone, invest life savings, build factory. 3) Poach skilled workers from competitors; use cheap labor to shape underwire (top). 4) Move factory after a year in hope of making more money.

how boss wang and boss gao became the lords of the (bra) rings

At 2:30 in the afternoon, the bosses began designing the factory. The three-story building they had rented was perfectly empty: white walls, bare floors, a front door without a lock. You could come or go; everything in the Lishui Economic Development Zone shared that openness. Neighboring buildings were also empty shells, and they flanked a dirt road that pointed toward an unfinished highway. Blank silver billboards reflected the sky, advertising nothing but late October sunlight.

Wang Aiguo and Gao Xiaomeng had driven the 80 miles from Wenzhou, a city on China's southeastern coast. They were family—uncle and nephew—and they had come to Lishui to start a new business. "This whole area just opened up," Boss Gao explained, when I met him at the factory gate. "Wenzhou used to be this way, but now it's quite expensive, especially for a small company. It's better to be in a place like this."

On the first floor, we were joined by a contractor and his assistant. There was no architect, no draftsman; nobody had brought a ruler or a plumb line. Instead, Boss Gao began by handing out 555-brand cigarettes. He was 33 years old, with a sharp crewcut and a nervous air that intensified whenever his uncle was around. After everybody lit up, the young man reached into his shoulder bag for a pen and a scrap of paper.

First, he sketched the room's exterior walls. Then he started designing; every pen stroke represented a wall to be installed, and the factory began to take shape before our eyes. He drew two lines in the southwest corner: a future machine room. Next to that, a chemist's laboratory, followed by a storeroom and a secondary machine room. Boss Wang, the uncle, studied the page and said, "We don't need this room."

They conferred and then scratched it out. In 27 minutes, they had finished designing the ground floor, and we went upstairs. More cigarettes. Boss Gao flipped over the paper.

"This is too small for an office."

"Put the wall here instead. That's big enough."

"Can you build another wall here?"

In 23 minutes, they designed an office, a hallway, and three living rooms for factory managers. On the top floor, the workers' dormitories required another 14 minutes. All told, they had mapped out a 21,500-square-foot factory, from bottom to top, in one hour and four minutes. Boss Gao handed the scrap of paper to the contractor. The man asked when they wanted the estimate.

"How about this afternoon?"

The contractor looked at his watch. It was 3:48 p.m.

"I can't do it that fast!"

"Well, then tell me early in the morning."

They discussed materials—paint, cement, cinder blocks. "We want the ten-dollar doors," Boss Wang told the contractor, who was a Lishui native. "And don't try to make money by getting cheaper materials—do a good job now, and we'll hire you again. That's how we make money in Wenzhou. Do you understand?"

a sea of commodities

The Wenzhou airport bookstore stocks a volume titled, *Actually, You Don't Understand the Wenzhou People.* It shares a shelf with *The Feared Wenzhou People, The Collected Secrets of How Wenzhou People Make Money,* and *The Jews of the East: The Commercial Stories of Fifty Wenzhou Businessmen.* For the Chinese, this part of Zhejiang Province has become a source of fascination, and the local press contributes to the legend. Recently, Wenzhou's *Fortune Weekly* conducted a survey of local millionaires. One question was: If forced to choose between your business and your family, which would it be? Of the respondents, 60 percent chose business, and

20 percent chose family. The other 20 percent couldn't make up their minds.

From the beginning, an element of desperation helped create the Wenzhou business tradition. The region has little arable soil, and the mountainous landscape made for bad roads to the interior. With few options, Wenzhou natives turned to the sea, developing a strong trading culture by the end of the Ming dynasty, in the 17th century. But they lost their edge after 1949, when the communists came to power and cut off overseas trade links, as well as most private entrepreneurship. Even in the early 1980s, when Deng Xiaoping's free-market reforms began to take hold, Wenzhou started with distinct disadvantages. Residents lacked the education of people in Beijing, and they didn't attract the foreign investment of Shanghai. When the government established the first Special Economic Zone, whose trade and tax privileges were designed to spur growth, they chose Shenzhen, which is near Hong Kong.

But Wenzhou had the priceless capital of native instinct. Families opened tiny workshops, often with fewer than a dozen workers, and they produced simple goods. Over time, workshops blossomed into full-scale factories, and Wenzhou came to dominate certain low-tech industries. Today, one-quarter of all shoes bought in China come from Wenzhou. The city makes 70 percent of the world's cigarette lighters. Over 90 percent of Wenzhou's economy is private.

The Wenzhou Model, as it became known, spread throughout southern Zhejiang Province. Although nearly 80 percent of all Zhejiang entrepreneurs have a formal education of only eight years or less, the province has become the richest in China by most measures. The per capita incomes for both rural and urban residents are the highest of any Chinese province (this excludes specially administered cities such as Shanghai and Beijing). Zhejiang reflects China's economic miracle: a poor, overwhelmingly rural nation that has somehow become the world's most vibrant factory center.

Over the course of a year, I traveled repeatedly to Zhejiang, every time renting a car in Wenzhou and driving into the province. In the same way that a pilgrim treks across Spain, stopping at the shrines of obscure saints, I passed the birthplaces of products that are usually taken for granted. From the airport, driving south along the coast, I started with hinges—a stretch of road where the vast majority of billboards advertised every possible variation of the piece of metal used to swing a door. A mile later, the ads shifted to electric plugs and adapters. Then I reached a neighborhood of electric switches, followed by fluorescent lightbulbs, then faucets.

Deeper in the province, the shrines became more elaborate. At Qiaotou, I stopped to admire the 20-foot-high silver statue of a button with wings that had been erected by the town elders. Qiaotou's population is only 64,000, but 380 local factories produce more than 70 percent of the buttons for clothes made in China. In Wuyi, I asked some bystanders what the local product was. A man reached into his pocket and pulled out three playing cards—queens, all of them. The city manufactures more than one billion decks a year. Datang township makes one-third of the world's socks. Songxia produces 350 million umbrellas every year. Table tennis paddles come from Shangguan; Fenshui turns out pens; Xiaxie does jungle gyms. Forty percent of the world's neckties are made in Shengzhou.

Datang makes one-third of the world's socks. Songxia produces 350 million umbrellas every year. Xiaxie does jungle gyms.

Everything is sold in a town called Yiwu. For the Zhejiang pilgrim, that's the promised land—Yiwu's slogan is "a sea of commodities, a paradise for shoppers." Yiwu is in the middle of nowhere, a hundred miles from the coast, but traders come from all over the world to buy goods in bulk. There's a scarf district, a plastic bag market, an avenue where every shop sells elastic. If you're burned out on buttons, take a stroll down Binwang Zipper Professional Street.

The China Yiwu International Trade City, a local mall, has more than 30,000 stalls—if you spend one minute at each shop, eight hours a day, you'll leave two months later. Yiwu attracts so many Middle Eastern traders that one neighborhood has become home to 23 large Arabic restaurants, as well as a Lebanese bakery. I ate dinner at Arbeer, a Kurdish joint, with a trader from northern Iraq. He was buying blue jeans and electric lamps.

In the past, Lishui was the only major Zhejiang city that wasn't on the pilgrim's route. It's high in the mountains, where the Ou River runs too shallow for big boats; one local described it as the Tibet of Zhejiang. That was an oxymoron—the Alaska of New Jersey—but he made his point: In an industrial landscape, Lishui was the final frontier. It was the poorest city in China's richest province, but the new highway was almost finished, and investors were moving in fast.

the memory of liu hongwei

Three months after designing the factory, Boss Gao and Boss Wang tested the equipment. Since my first visit, they had poached half a dozen skilled workers from another factory in southern China, and an assembly line had been installed. The 50-foot-long machine lurked sullenly in the corner room, six tons of steel painted sea green.

The thing rumbled when the head technician threw the switch. Gas burners hummed beneath blue flames; a stainless steel belt lurched forward. The digital console tracked the rising temperature: 200 degrees Celsius, 300 degrees, 400. It hit 474, then dropped. They needed to reach 500 before production could begin.

"Maybe it's because it's colder here than in Guangdong," the technician said. His name was Luo Shouyun, but everybody called him Mechanic Luo. He put on a pair of fireproof gloves and tried to open the door to one of the machine's ovens. But the handle melted off in his hand; he dropped it, cursing. The red-hot piece of metal lay on the floor, hissing like an angry snake.

"*Mei shir*," Boss Wang said. "No problem."

Mechanic Luo fiddled with the control box. He theorized that the natural gas canisters might be too cold. The men adjusted the valves and began to rock the massive metal tubes. The temperature didn't rise. They shook the tubes harder; nothing happened. Somebody went to get a stepladder and boiling water.

Boss Gao looked even more skittish than usual; he'd never installed such a big assembly line. More than a decade ago, he had started his first workshop in the outskirts of Wenzhou. With his parents and two sisters, he produced the fabric that lines the waist of cheap trousers. Initially, profits were 50 percent, and the workshop steadily expanded. But the neighborhood became home to more than 20 other companies making trouser lining, and the margins dropped until Boss Gao finally quit. "It used to be that you'd try to find a product that nobody else was making," he explained. "But now everything is already being made by somebody in China."

That's one weakness of the Wenzhou Model. Entrepreneurs produce goods that require little capital and low technology, which makes it easy for neighbors to jump in. Boss Wang, the uncle, had slipped into the same pattern. Previously, he had manufactured the steel underwire for women's brassieres, and his profits had dropped steadily. When the two men joined forces, they decided to continue manufacturing underwire, but their goal was to find a more profitable main product.

Fortunately, the average bra is composed of 12 separate components. In a figurative sense, the men began their quest at the bottom, with the underwire, and worked their way up. They thought about thread; they looked at lace; they considered the clasp. But when they reached the top, where tiny 0- and 8-shaped rings adjust the bra straps, they found what they were looking for.

A bra ring consists of steel coated with high-gloss nylon, requiring a specialized manufacturing process. The key equipment is a computer-regulated assembly line, divided into three separate stages, each of which heats the object to over 500 degrees Celsius. Originally, Europeans produced the rings, but by the early 1990s Taiwan dominated the market. In the middle of that decade, *(Continued on page 102)*


n, a plot of Western-style villas, rises
the
backs
40-cents-an-hour
laborers hauling concrete. Homes
sell for
half a million
ollars, affordable for the city's eli
factory managers, top
eaucrats, and land develo
s.

AUGUST 2005: FARMLAND

OCTOBER 2005: FOUNDATION

FEBRUARY 2006: SHELL FINISHED

APRIL 2006: SIDING WORK

DECEMBER 2005: LOWER FLOORS

AUGUST 2006: INTERIOR WORK

fast-forward

Changing at the speed of capitalism, Lishui makes room for its population explosion. Photographs taken periodically over 13 months capture the rise of Xiahe New Village—government-designed middle-income apartment buildings complete with solar panels. Street-level spaces will be rented for shops and piecework factories. Most apartments are bought by former country dwellers displaced by real estate and infrastructure projects.

unstoppable cities

Mountains pose no obstacle to Lishui officials as they clear land for the industrial reshaping of their city. To create a 5.6-square-mile factory zone (opposite), engineers razed 108 hilltops. Aiming to double the city's population to half a million by 2020, planners intend to open ■ second, larger zone, joining the trend of cities gobbling up land across China.

a mainland Chinese company called Daming imported an assembly line.

After its arrival on the mainland, where production costs are much cheaper, "the Machine" essentially minted money. The boss got rich, and then a worker named Liu Hongwei got an idea. Despite his lack of formal education, Liu was a skilled mechanic, who worked closely with the Machine. Meticulously, he memorized the assembly line, piece by piece, and in secret he sketched out blueprints. When the plans were complete, he contacted a second boss at a company called Shangang Keji, in the city of Shantou.

In 1998, Boss Number Two hired Liu and took the blueprints to Qingsui Machinery Manufacture Company, in Guangzhou, which custom-built the assembly line. Initially, the new Machine didn't work—nobody's memory is perfect, after all—but two months of adjustments solved the problems. Shangang Keji began producing bra rings, but then Liu found Boss Number Three, at a company called Jinde. Every time Liu jumped, he demanded money for his blueprints and expertise; some believe he made as much as $20,000.

Without knowing it, the man was following a path blazed by other societies that had also experienced sudden manufacturing booms. In 1810, a wealthy American named Francis Cabot Lowell traveled to England, where he used his connections to tour the world's premier textile mills. British law forbade the export of machinery or blueprints, but Lowell had an excellent memory. He returned to the United States, where, in the words of his business partner, he re-invented the Cartwright loom. Lowell became an American hero, with a Massachusetts factory town named in his honor.

Nearly two centuries later, Liu Hongwei's luck ran out when he tried to switch to Boss Number Four. According to a former co-worker, Number Three put a $12,000 bounty on Liu's head, and he fled. "I know that Jinde was looking for him, and they were angry," said Gu Hong, a Qingsui business manager who had helped custom-build the Machine. "He disappeared."

The industry, though, had already been changed. In the five years after Liu's re-invention, the bra-ring price dropped by 60 percent. Today, more than 20 Chinese companies manufacture the object, and the Machine is available to

anybody with $65,000. Previously, all major manufacturers had been concentrated in the south, but now Boss Gao and Boss Wang hoped to be the first to make rings in Zhejiang.

On the day they tested the Machine, the temperature refused to budge, and the men took turns standing on the stepladder and dumping buckets of boiling water over the gas canisters. Half an hour later, steam filled the room, and they had discovered a new axiom: Pouring boiling water on natural gas canisters has no effect on the production of bra rings.

After four hours of testing, they gave up. In the end, Mechanic Luo disassembled the Machine, replaced a key part, and moved the burners closer to the assembly line. It took nearly two weeks. Some sections of the Machine had to be jury-rigged with plywood and string; they never reattached the melted handle. "The blueprints still aren't very good," Mechanic Luo explained. Years ago, he had worked alongside Liu Hongwei, and he said the same things about the technology thief that I heard from others. Liu was tall, devious, and from Sichuan Province. People speculated that Liu wasn't his real name, and they had never met his wife or child. Nobody had any idea where the man had gone.

moving mountains

The government motto of the Lishui Economic Development Zone is "Each person does the work of two; two days' work is done in one." The slogan may be too modest. From 2000 to 2005, the city's population went from 160,000 to 250,000, and the local government invested 8.8 billion dollars in infrastructure for the region it administers. During those five years, infrastructure investment was five times the amount spent in the previous half century. In money terms, what was once 50 days' work is now done in one.

For the past three decades, China's economy has averaged nearly 10 percent annual growth. The economy is fueled by the largest migration the world has ever seen: An estimated 140 million rural Chinese have already left their homes, and another 45 million are expected to join the urban workforce in the next five years. Most have gone to factory towns along the coast, but in recent years migrants have been drawn

increasingly to cities in the interior, where there's less competition for jobs.

Such cities must expand and attract industry on their own, because the central government no longer provides the funding and guidance of the old planned economy. One common strategy is to establish a factory zone: Clear out land, sell it at reduced rates, and give investors tax breaks. In 2002, Lishui began construction of a factory zone, which consists of a 5.6-square-mile plot to the south of the city proper. By 2006, nearly 200 plants had started production, attracting 30,000 migrant workers.

This early growth had been guided by Wang Lijiong, the 48-year-old director of the development zone. As a young man, Wang's first job had been in a dynamite factory, and then he spent five years driving a tank for the People's Liberation Army. Upon leaving the military, he worked in a state-owned bank, and then he began to rise through the government bureaucracy. He is friendly and open—qualities unusual for a Chinese official. He told me that he still draws inspiration from his military experience. "In a tank, you go directly at your goal," he said. "You need the spirit of persistence."

Lishui's zone occupies what was previously rugged farmland. Director Wang told me that approximately one thousand peasants had been relocated, as well as exactly 108 separate mountains and hills. He said, simply, "We lowered the higher places and raised the lower places." During one of my earlier trips to Lishui, I had watched a higher place get lowered. There were 30 dump trucks and 11 Caterpillar excavators; workers had just packed the hillside with 9.9 tons of dynamite. Eventually, this site would become home to a half dozen chemical factories.

A worker noticed me and walked over. In each hand, he carried a cheap plastic shopping bag filled with explosive. He set the bags on the ground and said, "Will you take my little brother to New York?"

Having lived as a foreigner in China for a decade, I was accustomed to non sequitur conversations, but that opener left me speechless. Anyway, I couldn't take my eyes off those plastic bags. The man smiled and said, "I'm joking. But he really wants to go to America."

A local mall has 30,000 stalls—if you spend one minute at each shop, eight hours a day, you'll leave two months later.

He introduced me to Mu Shiyou, who was in charge of detonation. Mu and I walked to the base of the doomed hill, where a tangle of wires connected to the packed dynamite. He spliced the wires to a single line and payed it out as we walked away. All vehicles and workers had been evacuated; it was so quiet that I could hear birds overhead.

The detonator box had two switches labeled "Charge" and "Explode." We stood behind the treaded wheels of a parked Caterpillar. A command crackled over Mu's walkie-talkie: "Charge!"

He hit the switch and said, "Get out there where you can see it better!" A countdown, another command ("Explode!"), and he flipped the second switch. For the briefest instant, before there was any sound, a web of electricity flickered across the hillside, like lightning come to earth.

willing to eat bitterness

On February 6, half a month after testing the Machine, Boss Wang officially opened the factory by igniting two boxes of fireworks. According to the lunar calendar, it was the eighth day of the new year, and a feng shui expert had advised the owners to take advantage of eight, a lucky number in China.

Like most Wenzhou businessmen, Boss Wang was deeply superstitious. He had a high-pitched voice and a slight stutter; his eyelids fluttered rapidly when he spoke. He was 40 years old, and in the past he had always manufactured parts of objects: pieces of piping, pieces of bicycle bells, pieces of brassieres. In hindsight, he wished that as a young man he had gone into the shoe

business. "I have some regrets," he told me, because a number of his boyhood friends had become shoe-factory millionaires. Even in the new Lishui factory zone, where virtually everything was still under construction, the grass was already greener next door. Boss Wang's neighbor was Geley Electrical Co., whose owner had started as a lowly button manufacturer in Qiaotou before moving on to bigger and better things. Now Geley employed hundreds of workers, and the new factory produced three-dollar plastic electric outlets that were marketed proudly as the Jane Eyre model.

Boss Wang and Boss Gao gave their company the English name Lishui Yashun Underdress Fittings Industry Co., Ltd. Branding was instant: For less than $800, a Wenzhou designer created a logo, sample books, website, and business cards. Everything was hot pink; the website and sample books featured photographs of sultry foreign women wearing bras. The men's business cards bore the logo:

I wondered if the design represented a bird in flight, or maybe a heart, or perhaps a pair of—

"I don't know what it's supposed to be," Boss Wang admitted. "It doesn't matter, as long as it looks good. The designer probably took it from some other company."

Three days after setting off the fireworks, Boss Wang posted a handwritten job notice on the factory gate:

1. Ages 18 to 35, middle-school education
2. Good health, good quality
3. Attentive to hygiene, willing to eat bitterness and work hard.

All across the Lishui development zone, young people wandered in packs, reading the factory signs that had been posted at the end of the New Year holiday. At the local job fair, migrants gazed up at a digital board with listings so terse they read like code:

"Cashiers, women, 1.66 meters or taller"
"Willing to eat bitterness and work hard, 25 to 45 yuan a day, male, middle school"
"Male workers 35 yuan, female workers 25 yuan"
"Average workers, people from Jiangxi and Sichuan need not apply."

There were no euphemisms, no apologies. If a company preferred its women to be tall, they asked for tall women. If they had a prejudice against a certain region, tough luck. At a factory called Jinchao, the guard turned away all applicants from Guizhou, the poorest province in China. When I asked the manager why, he said, "Around here, a lot of the petty criminals are from Guizhou." At Yashun, Boss Gao's father handled the hiring, and I sat in on a job interview in which he asked an applicant how old she was. The woman said, "Do you mean my real age, or the age that's on my identity card?" She explained that seven years ago, when she had first left home, she'd forged the ID because she'd been so young. The man offered her a job; he told me that a woman like that must really enjoy working.

In China, minimum wage varies by region, and Lishui's is about 40 cents an hour. Yashun offered jobs at the lowest rate, but applicants poured in; there was no shortage of unskilled labor. Boss Gao's father kept a pile of bra rings on his desk, to show what the factory produced. On the second day, after the workers' list was full, he told an applicant that her name would be on the backup sheet.

"Just switch my name with somebody else's," she said.

"I can't do that. We already have enough. We have 19."

The woman had short-cropped hair and lively eyes; her identity card said she was 17. She leaned close to the desk and fiddled nervously with the bra rings, as if they were pieces in a game she was determined to win.

"Just change a name," she said. "Why does it matter?"

"I can't do that."

"I would have come yesterday if I'd known."

"I'll make sure you're first on the second list. See, I even wrote 'good girl' next to your name."

But the woman wouldn't give up. At last, after ten minutes of pleading, he added her name—but then the Wenzhou superstition


Outfitted in Prada and Piaget, Ji Shengjun, the 26-year-old son of a
farmer and construction worker who rose to become a real estate
tycoon, sports with the ladies at a nightclub he owns in Lishui. The
family business stands to make 19 million dollars in its latest deal.

Families dismantle homes to make way for a hydroelectric dam near Lishui. The government paid each family between $6,500 and $13,000 in compensation, not enough to buy a place in any of China's booming cities. Another giant project, the Zijin Bridge over the Ou River (top), will link Lishui to a new highway and factories.

struck. "Now it's *ershi,*" he said. "Twenty. That's a bad-sounding number—too much like *esi,* starving to death. So I'll have to add another."

The woman thanked him and headed toward the door.

"But if the boss says 21 is too many, then it'll have to be 19," he warned her.

The woman walked back to the desk. "Move my name up the list."

Five minutes later, her name was squarely in the middle of the sheet. When she finally left, the man shook his head admiringly. He said, "That girl knows how to get things done."

Later they realized that she had used her older sister's identity card. The girl who got things done, it turned out, was barely 15 years old.

even the fountains make music

The first time I visited the factory, the road in front was dirt, and the development zone's billboards were mostly blank. By my second visit, six weeks later, the Yintai real estate company had posted an advertisement. The road was being paved during my third trip. On the fourth, I saw a woman drive the front left wheel of her Honda into an open manhole. The manhole covers were installed by my fifth visit. A medical clinic appeared before the sixth trip. Sidewalks and streetlights by the seventh. Trees and bus stops by the eighth.

Factory production didn't wait for finished infrastructure, and neither did daily life. In a Chinese development zone, construction sites are essentially public space, and the factory's street hosted all sorts of makeshift entertainment. One week, a traditional Wu opera troupe erected a stage in the middle of the road; later, a traveling carnival set up shop. Every month, the local government parked a truck at an intersection, unfurled a white screen, and showed a free double feature. Nearby, a real estate company used its construction site to sponsor the Harmonious Sound Workers' Karaoke Contest. Representatives from local factories competed, and over 12,000 workers came to watch. The winner was a security guard from a plant that made down blankets and clothing. He sang a popular love song—"A Woman's Heart."

One week, the Red Star Acrobatic and Artistic Troupe came to town. Their battered truck had side panels that unfolded to reveal a marquee with photographs of half-dressed women, along with bright slogans (Passion! Perfection!). The truck's body converted into a box office; they pitched a tent in back. Admission was 60 cents, and 160 people bought tickets—almost all men. Troupe members sang songs and performed skits; one man acted out the heartbreaking story of a migrant imprisoned for theft. Another man popped his shoulder out of its socket and writhed on stage while his brother took up a collection. At the end, a woman stripped.

It was all illegal. Nude shows are banned in China, and the troupe wasn't registered; no one even had a driver's license. They were an extended family from Henan Province, bouncing their way south—in succession, they'd been kicked out of Nanjing, Hangzhou, and Yongkang. When I asked Liu Changfu, the troupe leader, why they included nudity, he said, "Before people buy tickets, they often ask if we have some 'open entertainment.' We need to be able to say yes." The task of stripping fell to the wife of the most distant cousin. Liu told me they were profitable as long as they kept moving, and there was always another half-built development zone down the road.

Lishui depended as much on construction sites as did the itinerant entertainers. Chinese cities aren't allowed to raise funds through municipal bonds or sharp tax increases, so they turn to real estate. Legally, all land belongs to the nation, but local governments can approve the sale of land-use rights—the closest thing to private ownership. Cities acquire suburban land from peasants at artificially low set rates, approve it for development, and sell for a profit on the open market. Across China, an estimated 40 to 60 percent of local government revenue is acquired in this way.

New apartment complexes were rising all around Lishui, and one of the biggest was the Jiangbin development. Formerly, the 16.5 acres had belonged to the village of Xiahe, but in 2000

the city government bought the land-use rights for one million dollars. Three years later, Lishui flipped the land to Yintai Real Estate for 37 million dollars. Given that corruption is endemic in Chinese real estate, the actual price may have been even higher.

In such an environment, everybody gambles on growth. Most of the city's massive investment in infrastructure had been borrowed from state-owned banks, which also loaned money to the developers—Yintai had borrowed over 28 million dollars for its Jiangbin venture. If the real estate market went cold, the whole system was in trouble, and the central government had recently instituted new laws intended to slow down such expansions. But the money kept pouring in—during the past five years, the average price of a Lishui apartment had risen sixfold.

On paper, it looked untenable, but the Chinese economic and social environment is unlike anything else in the world. Real estate laws are skewed in the government's favor, and migration and the export economy create a constant demand for expanding cities. After the hard times of the 20th century, the average citizen is willing to tolerate unfairness as long as his living standard improves. In Jiangbin, I met Zhang Qiaoping, whose family had formerly farmed one-third of an acre on the site. The government paid him $15,000 for a plot of land that was worth at least $200,000. Zhang wasn't happy, but he hadn't protested; instead, he invested in a small shop next to the site. Most customers were construction workers. There wasn't much money trickling down to the lowest levels, but Zhang had tapped into enough to support his family.

Some peasants even made it to the top. Yintai is owned by the Ji family, whose patriarch had been a farmer before engaging in small-scale construction work in the 1980s. Eventually, he expanded into real estate, and now his three sons help manage the company. I met the youngest, Ji Shengjun, at the nightclub he owns. Flanked by his bodyguard, the 26-year-old was drinking Matisse scotch mixed with green tea, and listening patiently to the entreaties of a pretty young woman. Ji wore Prada trousers and a Versace shirt; his Piaget watch had cost $10,000. He told me that Yintai expected to profit 19 million dollars from Jiangbin. The apartment complex would feature a musical fountain bigger than a football field. The pretty young woman was begging Ji to help her acquire a visa to Portugal.

A medical clinic appeared before my sixth trip. Sidewalks and streetlights by the seventh. Trees and bus stops by the eighth.

a negotiated child

Much of China's economy depends on peasants who have left the land, and that was also true at the Yashun factory. Boss Wang and Boss Gao come from rice-growing families; Mechanic Luo was born on a cotton plot. A former orange grower worked the metal punch machine, and the chemist had grown up with tea, tobacco, and peanuts. The assembly-line women knew wheat and soybeans. The accountant came from pear country. Despite their varied rural backgrounds, now everybody concentrated on the production of exactly two things: underwire and bra rings that weigh half a gram each.

Even the bosses were willing to work like peasants—every day, the men spent long hours on the factory floor. Each had invested his life savings in the business—cash—and only Boss Gao had borrowed a little from the bank. There was no management board, no investment schedule, no business plan. They began production without a single guaranteed customer. Throughout March and April, Boss Wang traveled to bra assembly plants, bearing gifts: Chunghwa cigarettes, Wuliangye alcohol, yellow croaker fish (a Wenzhou favorite). But potential customers were slow to make orders, and by summer the factory had over one million bra rings in storage. They laid off most unskilled workers and slashed the technicians' salaries in half.

Initially, the bosses had moved with remarkable speed, but now they paid for the lack of a system. Such institutional weaknesses are becoming more apparent in Chinese businesses because of the increasingly competitive environment. And the nation's next desired economic stage—innovative products and the creation of international brands—will require more creativity and logical organization.

At Yashun, only Boss Gao had as much as a trade-school education, and Mechanic Luo, the most important employee, hadn't finished elementary school. When he began working full-time at the age of 14, he was nearly illiterate, but he enrolled in night classes in Shenzhen. Such courses are common in Chinese boomtowns, and Luo eventually received his high school certification. He also acquired technical skills that allowed him to work with the Machine, and over the years he had been poached three times from bra-ring jobs. Along the way, his salary had risen to $760 a month, a high wage in China. As is common in the cutthroat factory world, he left every job without notice. Each time, he simply asked for a few days' vacation, changed his cell phone number, and never returned.

When Yashun struggled, the bosses cut Mechanic Luo's salary in half, and then they stopped paying him at all. Perversely, this reflected his value—he was the only person who understood the Machine. During a crisis, small Chinese factories sometimes withhold salaries, because workers won't leave when they're owed money. Everything came to a head in July, when Mechanic Luo's wife was about to give birth. She was in his hometown in Hubei Province, and he told me that this would be their second child.

The bosses refused to grant leave. On July 27, the baby was delivered by C-section, and Mechanic Luo told the bosses that he absolutely needed to return, to help his wife recover from surgery. Finally, they agreed, but they balked on paying the back salary. That evening, when I took Mechanic Luo out for a celebratory dinner, negotiations were still in progress. In the end, the bosses paid one-third of what they owed him, and he promised to return within a week.

Later, the mother and baby traveled 21 hours by bus to Lishui. They shared the factory dorm room with Mechanic Luo, who proudly introduced me. I asked how the child's brother was doing; I assumed he was still in the village with his grandparents. But the man's face fell, and I feared that something terrible had happened.

"This is actually our first child," he said, dropping his voice. "When Boss Wang and Boss Gao hired me, I told them I already had a son, so I could ask for a higher salary. I didn't want to lie to you, but they were around when we were talking."

After two months, his wife took the baby back to her home province of Guizhou. At the Guiyang rail station, two women approached and offered her a ride. They led her to a minivan that contained two men. After they left the city, she noticed a strong chemical smell and felt disoriented. The next thing she knew, they had robbed her of $120 in cash, her cell phone, and her earrings. Afterward, the baby was unusually sleepy, and the mother called Mechanic Luo in a panic. He told her to wash the child immediately. Since then, the baby had seemed healthy. Not yet four months old, he'd lived in a factory, served as a pawn in salary negotiations, and been drugged and robbed. Mechanic Luo had named him Wen, "cultured," because he dreamed of his son becoming an educated man.

a difference of three dollars

The 15-year-old at the factory had dropped out of school after the seventh grade because her family needed money. Nobody at the factory seemed to mind that she had initially used her older sister's name. In China, where the legal working age is 16, it's common for workers to register with false IDs. In fact, the sister ended up working there, too, as did the father. Their name was Tao, and they had migrated from Anhui Province. Unlike most workers, they lived in a rented room nearby instead of the factory dorm. During the summer months, when the plant verged on failure, the Taos were rarely called in to work. But then Boss Wang's courtship of customers finally *(Continued on page 116)*

Nightlife in Lishui's new factory zone happens in the streets, where carnivals, karaoke contests, and, on this evening, free kung fu movies entertain workers. Some 30,000 migrants have poured in during the past few years, many living in worker dormitories.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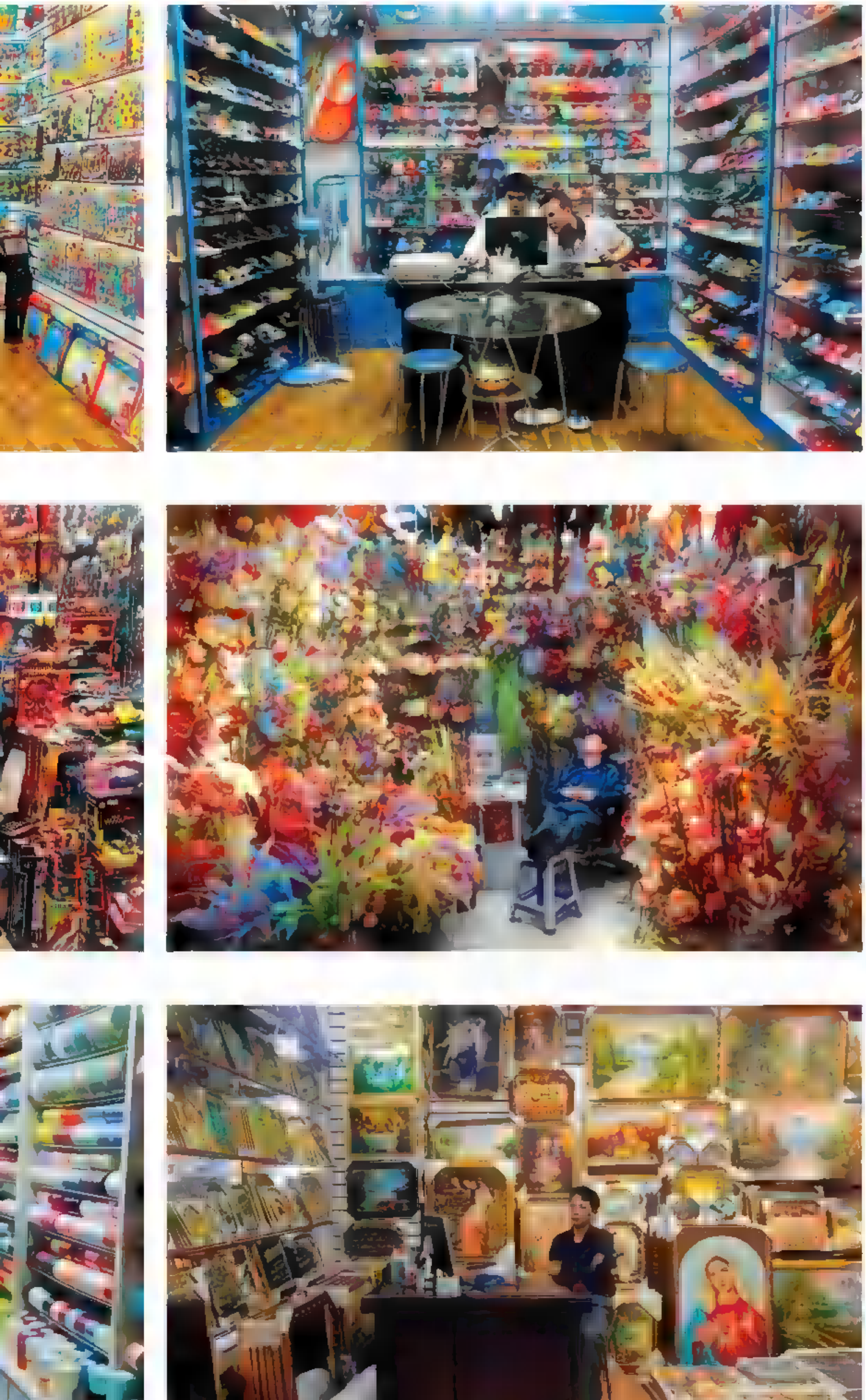


buy time

Factory fresh, a kaleidoscope of products, from toy guns and plastic sandals to laughing Buddhas, await buyers at the International Trade City in Yiwu. The deals made here at the more than 30,000 stalls affect the retail price for items around the world—and ensure that in cities such as Lishui, yet another entrepreneur will open a factory to strike it rich.

began to pay off. By August, the factory had five steady buyers. In September, 11 months after the factory had been designed, it turned its first monthly profit. By October, business was good, and the Taos were working long hours every day.

The older sister sorted bra rings on the Machine's assembly line, while the 15-year-old, whose name was Yufeng, handled underwire. She placed the curved wires onto a spring that was sent into an industrial heater. The job paid by the piece, and on a good day Yufeng could finish 30,000 wires, for a wage of $7.50. She was quick, reliable, and completely self-possessed. She talked back to Boss Wang like nobody else. One evening, when a co-worker celebrated her 16th birthday, Yufeng used the occasion to bully her foreman into drinking shots. Chugging Sprite to his Double Deer beer, the girl was relentless. "Drink! Drink! Drink!" she shouted, turning to me and the other men at the table. "Toast him! I want to get him drunk so I won't have to work hard tomorrow!"

Yufeng, like her sister, gave all her earnings to the parents. Her dream was to open a shoe factory someday; she told me that if she became successful, she'd build a three-story home in her grandparents' village. When I asked about the grandparents, the girl's eyes filled with tears, and then I didn't ask about that anymore.

By November, the Machine was turning out 100,000 rings daily, and the bosses had installed a bigger assembly line for underwire. But like everybody in Lishui, they had gambled on rapid growth, hoping to expand to 60 workers by the end of the first year. In fact, they had only 20, and the building was three times bigger than necessary. "It's still too early," Boss Wang grumbled, when I asked about Lishui's development. "If we have to get a part, or do anything related to machinery, we have to go all the way to Wenzhou."

That month, the bosses decided to relocate the factory. The decision was instant; there was no consultation with Mechanic Luo or anybody else. Boss Gao found two available buildings in the marshlands north of Wenzhou, and then they consulted the feng shui expert. His advice was unequivocal: November 28 was also the eighth day of the lunar month, and you can't do better than double eights.

Most workers decided to move with the factory, but the Taos' situation was complicated. The mother ran a small dry goods stand nearby, and the youngest son was enrolled in a local middle school. If the father and daughters kept their jobs, the family would be divided. At the factory, the decision became a topic of daily discussion.

"You should be independent by now," Mechanic Luo said to Yufeng, one day at lunch. "You don't have a bank account, do you?"

"No," she said.

"You're still giving all your money to your parents!"

"They need my help."

"It helps more if you learn to be independent."

The man scoffed that he had first left home with only six dollars in his pocket. The way he told it, Yufeng was just another overprotected 15-year-old working 50 hours a week on an assembly line. But the father refused to leave the decision to his daughters. He insisted they would leave together—but only if the salary was renegotiated.

The night before the move, the bosses finally offered a raise. The father asked for more; the bosses dragged their heels. No one was willing to meet directly, so Mechanic Luo carried messages back and forth. At eight o'clock, he visited the Taos' mud-walled room. The girls went outside; the men lit West Lake cigarettes. The father said, "I'm not willing to move unless they make it worth my while."

"I know," Mechanic Luo said. "And I don't want to train new workers."

The mother said, "Maybe we should just send them to work in a shoe factory."

"Don't talk about that yet," the father said. "We need to figure this out first."

He demanded the same wage for everybody: a guaranteed 127 dollars a month, plus overtime, and six dollars in living expenses. Mechanic Luo returned to the bosses, who cut the expenses in half—a difference of three dollars. The father didn't reply, and that offer was still on the table when the night ended.

good days ahead

That fall, Lishui applied to add another 13.5 square miles to the development zone. The expansion would require an investment of almost 900 million dollars, most of which would come from bank loans. They planned to double the city's population by 2020. With energy demands rising, the Tankeng Dam was being constructed in the mountains south of Lishui. In preparation, 50,000 people were being relocated from 10 towns and 80 villages. I had watched the final evacuation of Beishan, the largest town, on October 25 of 2005—an auspicious date according to the feng shui experts. There were good days for everything, even abandoning your hometown. Families packed flatbed trucks full of furniture; they unloaded in eight new resettlement communities that had yet to be finished. In Youzhou, Chen Qiaomei told me she'd had trouble finding her apartment, which had no windows yet. "They all look the same!" she said.

When I talked about Lishui's factory zone expansion plans with Director Wang, he acknowledged that approval for such projects was becoming more difficult. The central government feared a real estate bubble, but he remained confident. "We're applying to develop an area where the land isn't good for farming," he explained.

On his office wall hung a map of the proposed expansion—future roads, industrial blocks, waterworks. "We'll have to move more than 400 mountains and hills," he said. He invited me to return in January, when his boy would be home for vacation. The son of the former tank driver was at the University of Auckland, studying international finance.

factory ghosts

They moved the bra-ring factory in one day. The bosses hired a forklift, four flatbed trucks, and seven laborers. Mechanic Luo disassembled the Machine into three parts; the finished bra rings were packed into 94 boxes. They removed everything of value, even the carpet and the lightbulbs. A year earlier, they had ordered ten-dollar doors, and now they took them off the hinges.

At three o'clock, the Tao sisters showed up with their bags packed. Their father, it turned out, had found a better-paying job for himself at a nearby factory that produced synthetic leather. He had arranged it days ago, in secret; the insistence on staying with his daughters turned out to be a negotiating ploy. There weren't any tears at the factory gate. The last thing the father said was, "You need to dress warmly. It's going to get cold, and you'll get sick if you're not careful. If you're sick, you'll have to spend money on medicine. So dress warmly, OK? Goodbye."

Two days later, I drove to the development zone, past rows of finished billboards: Amway, Haishun Steel Structure, Fengchang Steel Hooks. The former Yashun factory was unlocked. Inside, bra rings were strewed everywhere—bent rings, dirty rings, broken rings. There were crumpled cigarette packages and used rolls of tape. An empty diaper bag. A wall calendar frozen at November 22. A good luck charm with Mao Zedong's face on one side and a bodhisattva on the other. And throughout the dormitories, on the white plaster walls, graffiti had accumulated over the months. Next to his bed, one worker had listed numbers: winning lottery combinations. Another had inscribed, "Find success immediately." Others wrote:

"Reflect on the past, consider the future."

"Pass every day happily! A new day begins from right now!"

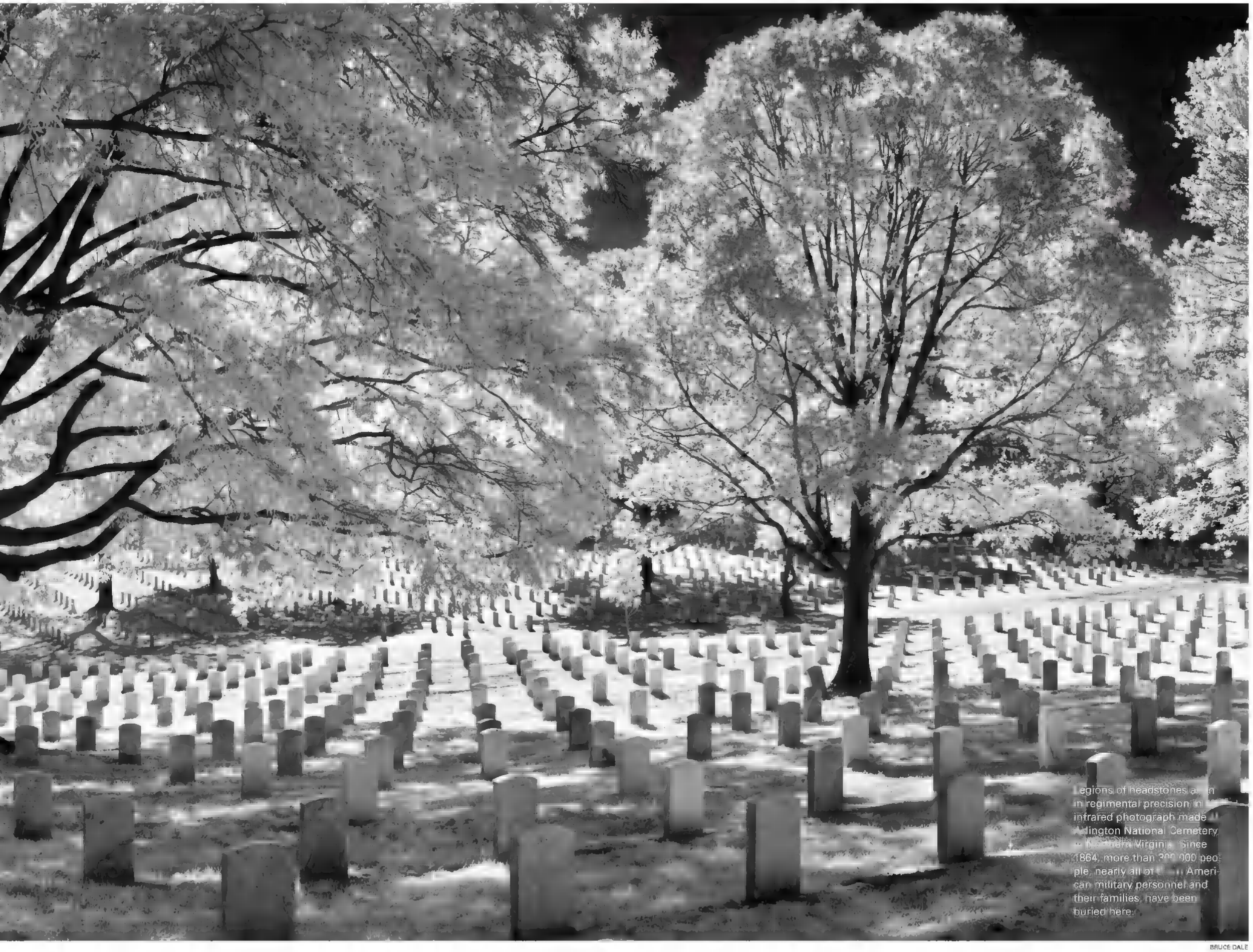
"Face the future directly."

"Leave the world."

"A person can become successful anywhere; I swear I won't return home until I am famous."

A cold wind blew against the windows. Outside, I heard neighboring plants—the rattle of glassmaking, the rumble of plastic molds, the pneumatic hiss of water heaters being produced. But there wasn't a single human sound, only the silent voices on the walls of the abandoned factory. □

Economic Windfall See more images of China's runaway urban development in our Photo Gallery at **ngm.com/0706.**



Legions of headstones align in regimental precision in this infrared photograph made at Arlington National Cemetery in Northern Virginia. Since 1864, more than 300,000 people, nearly all of them American military personnel and their families, have been buried here.

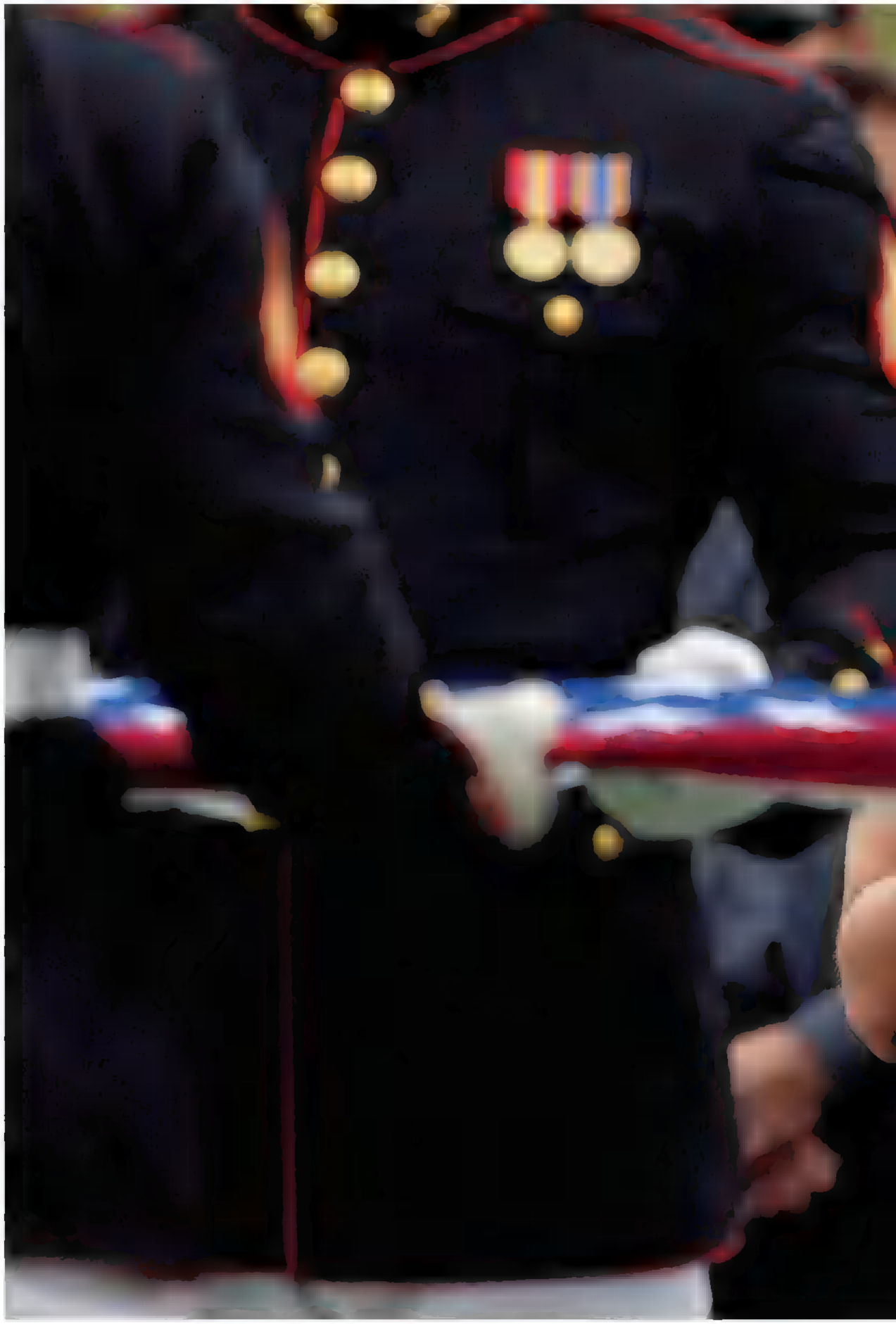
BRUCE DALE

No land in America is more sacred

than the square mile of Arlington National Cemetery. This has long been a liminal place, a threshold where the living meet the dead,

ARLINGTON

and where national history is intertwined with personal loss. Yet Arlington also is a shrine to valor and sacrifice, to service and fidelity. Those interred here tell a story not just of the Republic in war and in peace, but also of a transcendent ideal, conceived in liberty and reconsecrated in every new grave dug, every benediction murmured, every commitment into the hallowed ground. In this city of the dead, it is an ideal that lives on.

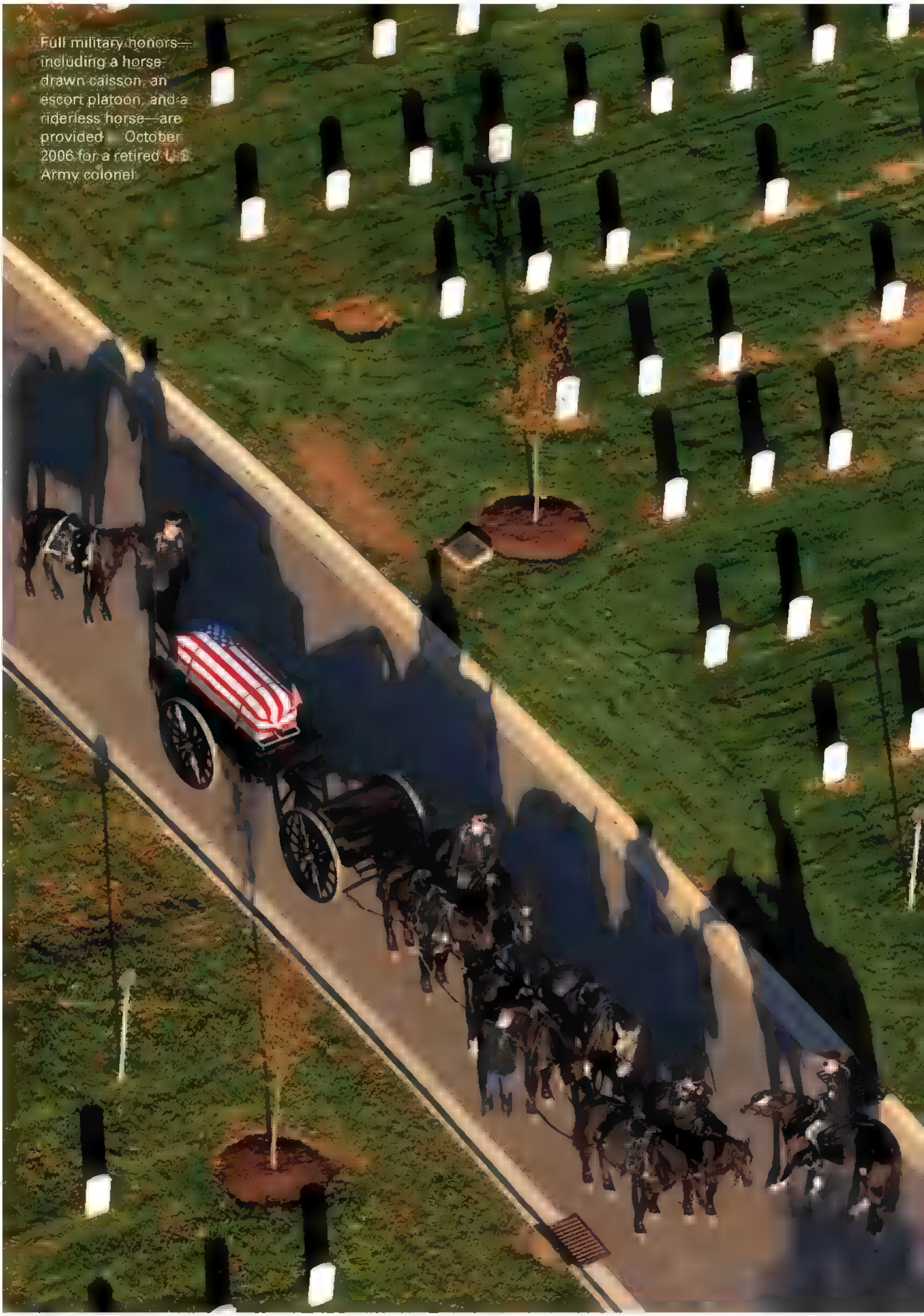


On June 14, 2006, Capt. Lisa Doring of the U.S. Marine Corps buried her husband, Capt. Nathanael James Doring, at Arlington National Cemetery. They both were serving in Iraq when his helicopter crashed in an accident.

TECH. SGT. STACI McKEE, USAF (OPPOSITE AND ABOVE)

Etched on the arch of Memorial Amphitheater, a pledge from Abraham Lincoln's Gettysburg Address resonates still: "We here highly resolve that these dead shall not have died in vain."

WENDY GALIETTA



LT. COL. MICHAEL EDRINGTON, USA

The Nation's Cemetery

BY RICK ATKINSON

Nothing in William Henry Christman's brief life suggested that in death he would become a singular figure in American history. A laborer from Lehigh County, Pennsylvania, Christman enlisted in the U.S. Army on March 25, 1864, for a $60 cash bounty and a $300 promissory note from his government. The muster rolls of the 67th Pennsylvania Infantry Regiment recorded that he was five feet seven and a half inches tall, with sandy hair, gray eyes, and a florid complexion. Twenty-one years old and unmarried, he bore a scar on the left side of his neck and three prominent moles on his back.

"I em well at the preasant time ant hope that my few lines will find you the same," he wrote his parents from Philadelphia on April 3, 1864. Military life suited him, he added. "I like it very good. We have enuph to eat and drink."

Three weeks later young Christman was hospitalized for measles. He grew sicker, and on May 1 was admitted to Lincoln General Hospital, a mile east of the Capitol in Washington, D.C. There, in Ward 19, on Wednesday, May 11, he died of peritonitis, a toxic inflammation of the membrane lining the abdominal cavity. An inventory of Christman's effects listed his modest legacy, including a hat, two flannel shirts, a pair of trousers, a blanket, a haversack, a canteen.

With the Civil War now in its fourth sanguinary year, Christman's body was among all too many bodies overwhelming the nation's capital. Every steamer up the Potomac River carried dead soldiers from Virginia battlefields, sheeted forms laid across the bows. Hospitals—often converted churches, public halls, or private mansions—ran out of burial space; more than 5,000 graves filled the Soldiers' Home cemetery alone. In desperate need of an expedient solution, Army quartermasters on May 13, 1864, trundled William Christman's mortal remains to a new burial ground that had been identified above the south bank of the Potomac on the confiscated estate of the Confederate commander, Robert E. Lee. The place was called Arlington.

Another Union soldier would be buried on the gentle slope near Christman later that Friday, with six more the next day and an additional seven on May 15. By the time the war ended the following year, some 16,000 graves stippled the rolling greensward at Arlington as part of a deliberate plan to ensure that the Lee family could never reoccupy the estate and to punish

DAVE BLACK

Tomb of the Unknowns honors three anonymous service members—from World Wars I and II and the Korean War. Bearing no names, the tomb speaks of a communal debt to the many whose ultimate sacrifice helped make a nation one.

Four and a half million visitors a year stroll beneath the white oaks and red maples, deciphering the nation's martial contours in the endless ranks of headstones that sweep from the ridgeline to the river flats below.

what many saw as General Lee's treason. With more than 600,000 dead in the Civil War, passions ran high.

In the 143 years since William Christman's burial those passions have cooled, but the veneration of Arlington as a place of reverence and remembrance has only increased. From the muddy potter's field of 1864, Arlington has grown to a vast necropolis of more than 300,000 dead in a leafy tract that has more than tripled in size from the original 200 acres. Of the 3.8 million square miles composing the United States of America, none is more sacred than the square mile of Arlington National Cemetery.

Here are buried Presidents and privates, five-star generals and anonymous souls known but to God. Here too are buried more than 370 recipients of the congressional Medal of Honor, and ten times that many Civil War "contrabands"—fugitive or liberated slaves. Arlington today holds dead veterans from every American war since the Revolution, including several hundred from the current conflicts in Iraq and Afghanistan, who are buried in section 60, perhaps the saddest acre in America today.

Four and a half million visitors a year stroll beneath the white oaks and red maples, deciphering the nation's martial contours in the endless ranks of headstones that sweep from the ridgeline to the river flats below. Two dozen or more funeral corteges roll through the cemetery each weekday, and the sounds of another soldier going to his grave—the clop of caisson horses, the crack of rifles, the drear blare of "Taps"—carry on the soughing wind from early morning until late afternoon.

FOR NEARLY A CENTURY after William Christman's interment, graves in the nation's best known cemetery were dug with a long-handled shovel, a task that took all day. In 1955 the purchase of a Trenchmaster excavator brought the gravedigging time down to 12 minutes and reduced the cost from $29 to less than $10.

These days a pair of three-man crews roams the cemetery with John Deere 310G backhoes, searching for the wooden stakes left by a surveyor

who measures and marks each new plot to be opened. On a late summer morning in section 2 on Arlington's upper slopes, 52-year-old Charles Montgomery eases his Deere among headstones covered with plastic trash cans to prevent accidental chipping.

"My job's just to dig the holes. Dig the holes, then cover 'em back up," Montgomery says. "I start my way in the back of the grave and work my way to the front, trying to keep it straight." Centering the backhoe boom on the headstone in an adjacent row, Montgomery gnaws at the earth with the steel teeth of his 32-inch bucket. This particular grave is an "open-up": A recently deceased 98-year-old rear admiral will be reunited with his wife, who was laid to rest on this spot, nine feet down, in 1991. His coffin will go atop hers, at seven feet. In five minutes a yawning hole has been dug, with the corners square, the sides true, and the spoil in a neat pile. "When I've got the bucket like this with the boom all the way down, that's seven feet," Montgomery says. "I been doin' this a long time, and I just know it."

After each interment a hydraulic tamper beats the earth to crush out air pockets. Still, subsidence requires refilling up to 10,000 graves each year. The dead in fact need perpetual care. Each day maintenance crews mow 130 acres, reset dozens of leaning headstones, and power-wash a thousand. (Water pressure must be carefully modulated to avoid chewing into soft marble, particularly the older stones such as those in sections 1 and 13.) Because the white-painted headboards used during the Civil War had to be replaced every five years—at $1.23 each—Arlington briefly experimented with markers made of a metal alloy from melted-down munitions. In the 1870s, the government adopted white marble for national cemeteries; the familiar slab used today was designed by a board of officers after World War I.

Twenty-four inches above ground, thirteen inches wide, and four inches thick, each marker accommodates only the sparest biographical details and brief terms of endearment, all within a maximum of 12 lines, 15 characters per line. Each stone can also carry a spiritual symbol, of which 38 have been authorized, from Episcopal to Muslim to atheist to Hindu.

More than 6,000 funerals a year end in Arlington. A daily spreadsheet lists them hour by hour, giving not only the location and depth of new graves but also a few hints of each life now ended: rank, next of kin, military service, whether the deceased was a decorated veteran. To prevent the corteges from colliding and to keep maintenance work at a respectful distance from graveside ceremonies, a sheaf of maps shows hourly funeral routes on the cemetery's 45 roads and walkways.

"The challenge is to ensure that we beautify the grounds without in any way compromising the grave sites," says Erik Dihle, a tall, blond Californian who is the chief of grounds and burial operations.

In Dihle's office, next to a Norfolk Island pine and an angel-wing begonia, a quotation from philosopher William James adorns a large wall map of Arlington: "The art of being wise is the art of knowing what to overlook." Regulations prohibit mourners from embellishing graves with artifacts or love tokens other than flowers. Yet in section 64 a grieving mother has placed several stuffed bears in a weeping willow near the grave of her son. "She has a whole little colony of teddy bears there," Dihle says with a shake of his head.

In section 60 the raw graves of the dead from Iraq and Afghanistan are appointed with little amulets for the next world: a ceramic fortune cookie; a bottle of beer; a spent 9-mm brass cartridge; a sliver of agate from the fallen soldier's native Kentucky; laminated photos of wives, sweethearts, children. On a smooth stone, a message neatly printed in indelible ink could crack the hardest heart: "I love you, Daddy. Happy birthday."

A SINGLE SHEET OF PAPER listed the 24 funerals scheduled for November 25, 1963, beginning with an Air Force Reserve colonel named Edward C. Forsythe at 9 a.m. in section 35. Yet it was the last of those two dozen ceremonies on the list, scheduled for 3 p.m. in section 45, that would forever change Arlington. With the name of the deceased's next of kin misspelled—perhaps reflecting the bewildered anxiety that afflicted cemetery officials, as it did all Americans—the entry read: "John Fitzgerald Kennedy, Cdr. in Chief. NOK: Jqcqueline Kennedy, widow."

In the decades after the Civil War, Arlington had grown at a modest rate. Among the most

THE NATION'S CEMETERY

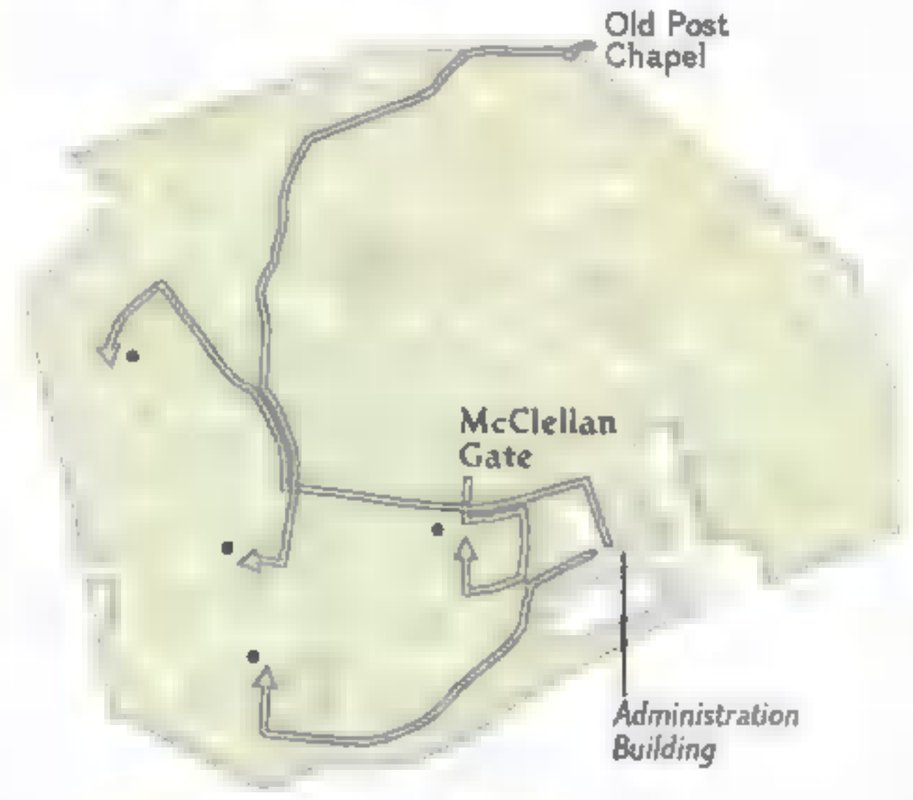
Choreography of the Hours

Arlington National Cemetery is perhaps the nation's most revered cemetery, and also among the busiest, averaging about 27 funerals a day. A typical morning in January 2007 shows how funeral crews, service members in dress uniform, groundskeepers, and other workers must follow an elaborate choreography to make each funeral feel as if it is the only one taking place.

⟹ • **Funeral** ⟶ • **Ceremony**

9:00 a.m.-10:00 a.m.

As funerals leave from the Administration Building and the Old Post Chapel, preparations are under way for a ceremony to honor a visiting Iraqi dignitary.



10:00 a.m.-11:00 a.m.

Funeral processions depart at 10:00 a.m., shortly before ■ howitzer salute greets the motorcade of the Iraqi chief of defense at the amphitheater. Five more funeral processions begin at 11 a.m.

INTERNATIONAL MAPPING (MAIN MAP). REPORTED BY HUGH K. TRUSLOW, NGM MAPS

SOURCES: ARLINGTON NATIONAL CEMETERY; ARLINGTON COUNTY DEPARTMENT OF ENVIRONMENTAL SERVICES; USGS; GEOEYE (REFERENCE IMAGE)

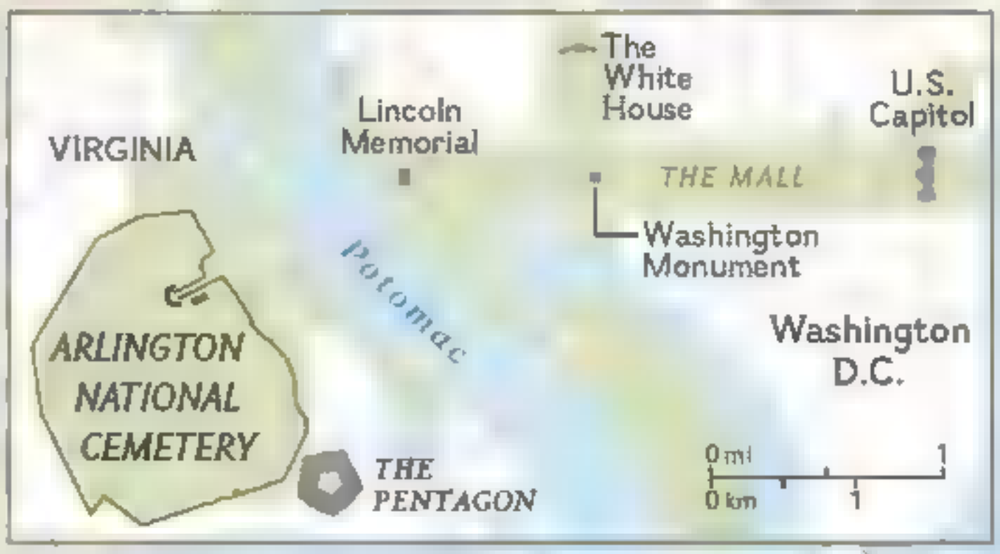
FORT MYER
Memorial Chapel
JACKSON CIRCLE
Confederate Monument
FARRAGUT DRIVE
GARFIELD DRIVE
LEE AVENUE
Old Post Chapel
McNAIR ROAD
Battle of the Bulge
McPHERSON DRIVE
Rough Riders
U.S.S. Maine
MEIGS DRIVE
HUMPHREYS DR.
Anita Newcomb McGee
LAWTON DRIVE
Nurses
U.S. Space Shuttle Challenger
Iran Rescue Mission
Canadian Cross of Sacrifice
CAPRON DRIVE
Spanish-American War
SIGSBEE DRIVE
Unknown Dead of 1812
Pan Am Flight 103
Superintendent's Lodge
MEMORIAL DRIVE
WILSON DRIVE
Audie Murphy
U.S. Space Shuttle Columbia
Gen. Philip Kearny Monument
Old Amphitheater
Administration
MARSHALL DRIVE
PORTER DRIVE
Crook Walk
Memorial Amphitheater
Unknown Civil War Dead
Arlington House (Robert E. Lee Memorial)
ORD & WEITZEL DRIVE
MITCHELL DRIVE
Tomb of the Unknowns
LEE DRIVE
Walter Reed
ROOSEVELT DRIVE
Joe Louis (Barrow)
Adm. William F. Halsey, Jr.
Pierre Charles L'Enfant
SHERMAN DRIVE
SHERIDAN DRIVE
Robert F. Kennedy
President John F. Kennedy
L'ENFANT DRIVE
Gen. George C. Marshall
Oliver Wendell Holmes, Jr.
LINCOLN DRIVE
Chaplains Monument
McCLELLAN DRIVE
U.S.S. Serpens
Sir John Dill
WEEKS DRIVE
Custis Walk
GRANT DR.
Samuel Dashiell Hammett
President William H. Taft
Women's Memorial
Gen. Omar N. Bradley
SCHLEY DRIVE
Medgar W. Evers
William Christman
McClellan Gate
EISENHOWER DRIVE
KING DR.
Beirut Barracks
Visitors Center
Parking
LEAHY DRIVE
BRADLEY DRIVE
YORK DRIVE
HALSEY DRIVE
Columbarium
Visitors Parking
Arlington Cemetery Metro Station
JEFFERSON DAVIS HIGHWAY
Arlington County VIRGINIA
Washington, D.C.
N

MAP KEY

- Monument or memorial
- 54 Section number
- Section boundary
- Fort Myer boundary

0 ft 1,000
0 m 200

Although all roads at Arlington are officially named drives, some signs still refer to them as avenues.



poignant events in the cemetery was the first Decoration Day—now called Memorial Day—on May 30, 1868. President Andrew Johnson gave all federal workers the day off for what was described as "the purpose of strewing with flowers, or otherwise decorating the graves of comrades." Wearing black satin sashes and singing "Father Come Home," children from the Soldiers' and Sailors' Orphan Asylum tossed blossoms on graves near the Custis-Lee mansion; Gen. James A. Garfield, who, as President 13 years later, would be sent to his own grave by an assassin's bullet, lauded those for whom "death was a poem the music of which can never be sung."

Kennedy's death transformed the national cemetery into a national icon. The President, during a visit to Arlington earlier that year, had unwittingly selected his own grave site. Surveying the serene vista below the original plantation house—the Custis-Lee mansion—he reportedly murmured, "I could stay here forever." Mrs. Kennedy approved the location the day after his assassination, and a grave was opened through the hard clay and oak roots. Since the solid mahogany casket weighed 1,200 pounds, military pallbearers in the small hours of November 25 practiced carrying a duplicate casket filled with sandbags and further deadweighted with two soldiers sitting on top.

The President's burial, a somber pageant of grace and dignity, was watched by a worldwide television audience. Within three years, 16 million visitors paid homage to the site in section 45, which was soon expanded to a three-acre sanctuary paved with Cape Cod granite and softened with sedum plants. The Institute of Gas Technology of Chicago installed an Eternal Flame as a beacon of remembrance. "It's as eternal as anything man-made can be," a cemetery official later observed.

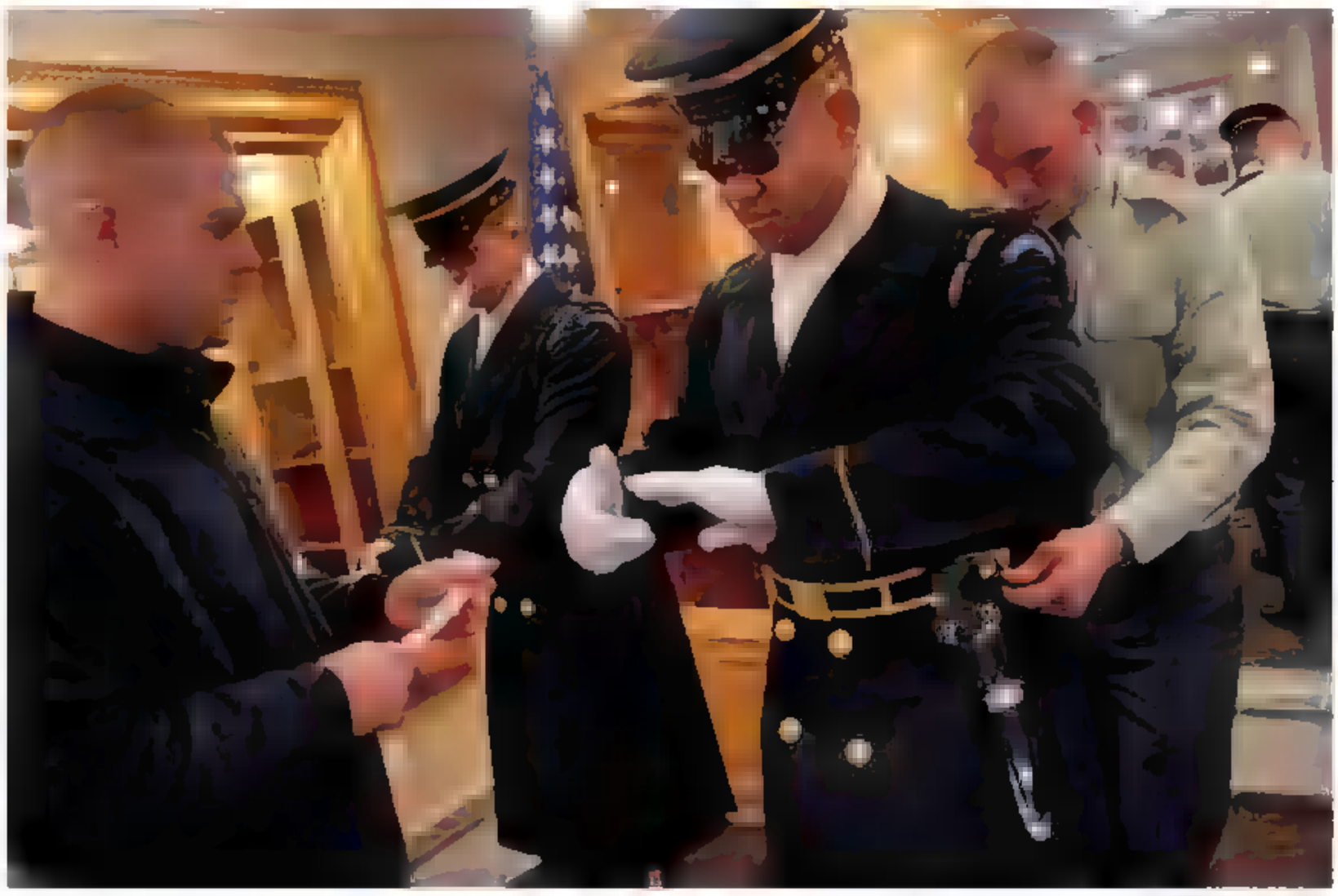
Requests for burial in Arlington abruptly swelled, a demand soon aggravated by more than 58,000 American deaths during the Vietnam War, when as many as 47 funerals in one day crisscrossed the cemetery. From the late 1950s until 2000, the number of graves would nearly triple, from almost 93,000 to 250,000. As cemetery officials searched for more contiguous land to augment Arlington's acreage, new eligibility rules imposed in 1967 sharply restricted burials to a small percentage of veterans, including those who die on active duty, those honorably retired after a career in the military, those highly decorated for valor, and their spouses.

Even a short stroll through Arlington is a perambulation through the American narrative. The graves of prominent military figures abound, of course, including World War II commanders like Gen. George C. Marshall, Gen. Omar N. Bradley, and Adm. William F. "Bull" Halsey, Jr. Beneath a simple government-issue stone in section 34 lies Gen. John J. Pershing, who led the American Expeditionary Forces in World War I. Steps away is the grave of his grandson, who was killed in Vietnam. Other veterans achieved fame in arenas beyond the battlefield, including boxer Joe Louis, author Dashiell Hammett, civil rights leader Medgar Evers, Associate Justice of the Supreme Court Oliver Wendell Holmes, Jr., and physician Walter Reed, whose headstone in section 3 notes that "He Gave to Men Control Over That Dreadful Scourge Yellow Fever."

The Tomb of the Unknowns began with the random selection of a single soldier in France from the Great War. Brought home aboard the U.S.S. *Olympia*, the casket was interred on November 11, 1921, and eventually surmounted by a sarcophagus—roughly 80 tons of Yule marble quarried in Colorado. During the ceremony, so heavily attended that it created what was described as "the greatest traffic jam in Washington's history," President Warren G. Harding voiced hope that the day would mark "the beginning of a new and lasting era of peace on Earth, good will among men."

It was not to be. Later conflicts produced more unknowns, and the site now contains remains from World War II and the Korean War. A Vietnam unknown, entombed in 1984, was exhumed in 1998 and reburied in St. Louis after DNA tests identified him as 1st Lt. Michael J. Blassie, an Air Force pilot shot down in May 1972.

Section 27 is particularly poignant, with stones devoid of dates and no more than the leanest biographical detail, such as "Mrs. Bannister, Citizen," or "Power Boy," or simply, "Civilian." Here nearly 4,000 African Americans are buried, many of them denizens of Freedman's Village, established in 1863 on the confiscated Arlington plantation as a so-called model community for emancipated slaves, runaways,



Pressed and polished per exacting standards, two members of the Army's Third Infantry Regiment (the Old Guard) get a helping hand from their comrades as they prepare for a shift as sentinels at the Tomb of the Unknowns.

DAVID ALAN HARVEY

By midmorning, honors are under way. "Every movement that these guys do has to have a cadence that's burned into their brains. The goal is to make the movements look mirrored, like you cloned one guy."

and those liberated by Union troops. The village was gone by 1900, but the dead remain. Other stones, inscribed "U.S.C.T.," commemorate U.S. Colored Troops who served the federal cause during and after the Civil War. If "in the democracy of the dead all men at last are equal," as poet and politician John James Ingalls proclaimed, some were more equal than others: Segregation by race and by rank in the cemetery held sway for decades before the ascent of contemporary egalitarianism.

Few national calamities remain uncommemorated at Arlington. The more recent tragedies still sear, such as the graves of 21 service members killed in the Beirut barracks bombing of 1983, or the memorial cairn to 270 people murdered by a terrorist bomb on Pan Am Flight 103 over Lockerbie, Scotland, in 1988. Of the 184 victims killed when American Airlines Flight 77 smashed into the Pentagon at 9:37 a.m. on September 11, 2001, 64 are buried in Arlington. In the final moments of its flight, the hijacked Boeing 757 screamed over the cemetery's southern edge at 530 miles an hour. The horrific impact flung debris several hundred yards into sections 69 and 70, which for more than a week remained an FBI crime scene.

HOUR BY HOUR, year by year, ritual and ceremony at Arlington link yesterday to today, providing a rhythm that dignifies death and consoles the living. The morning begins at 4 a.m. in the stables of the Third Infantry Regiment caisson platoon on adjacent Fort Myer. Soldiers assigned to the Old Guard shine their brass, clean the equestrian tack, and wash the horses to be used in the day's funerals —deep dents in the sheet metal lining the shower-room walls show that some steeds resent the predawn ablutions more than others. The platoon has its own coal-fired forge and master farrier, who shoes the horses every six weeks and adds borium studs for extra traction on Arlington's hilly roads. A platoon leatherworker, using the "1916 Field Artillery Harness Quartermaster Drawings" as a blueprint, fashions the reins, girths, and other tack from thick rolls of cured rawhide.

Fourth of July fireworks cascade over the nation's capital, reverberating across the river to Arlington. Soldiers from every American war, including the Revolutionary War, have been buried here, some reinterred at Arlington after the cemetery first began operations.

DAVE BLACK

Each ritual has its own intricacies. Many of today's military funeral traditions were born of expediency during the Civil War, explains Thomas L. Sherlock, Arlington's historian. There was a shortage of caskets, so flags were draped over bodies. A shortage of ambulances necessitated the use of caissons.

Today the funeral flag is boxed—folded 13 times into a trim triangle, stars out—in one minute and 54 seconds, precisely the duration of the hymn played by the band. Officers and the most senior noncommissioned officers of each service are still entitled to the caisson.

"Horse teams are in matched colors, all blacks or all grays," says Sgt. Jared Bolton. Six horses pull a 1918 artillery caisson that bears either a casket or an urn with cremated remains, placed on a tray that slides out of a mock casket. Soldiers in dress blues ride postilion style on the left mounts. Deceased Army or Marine Corps colonels and generals may also be honored with a caparisoned ("cap") horse—a riderless mount tacked with a saber and cavalry boots fitted backward in the stirrups to signify a fallen warrior looking back at his troops a final time. An ancient ritual, the cap horse was used in Lincoln's funeral but most famously in Kennedy's cortege, where the handsome, spirited Black Jack, a gelding Morgan and quarter horse cross, seemed representative of the slain President's vigor.

By midmorning, honors are under way and shots ring out across the cemetery. The seven soldiers in a firing party pull their triggers three times successively so that each volley of blanks sounds like a single shot, a particular challenge given that acoustics vary from section to section. "Every movement that these guys do with their weapons has to have a cadence that's burned into their brains," says Staff Sgt. Robert F. McLauchlin, who waits with the honor guard in section 54 to bury a retired colonel, a World War II veteran. "The goal is to make the movements look mirrored, like you cloned one guy."

No ritual is repeated more often, nor carries more enduring emotional power, than the playing of "Taps" at the end of a ceremony. It too has Civil War origins, having been composed in July 1862 during the Peninsular Campaign on Virginia's James River by Brig. Gen. Daniel Butterfield, who supposedly whistled a new tune for his brigade bugler to replace the bland "lights out" call previously used in Union bivouacs. Again, the most memorable rendition came during Kennedy's funeral when an Army bugler, numb from standing outdoors for nearly three hours, cracked the sixth note. It was "like a catch in your voice, or a swiftly stifled sob," wrote author William Manchester.

Today more than 50 military buglers play at Arlington, including Army Master Sgt. Allyn Van Patten, who estimates he has blown "Taps" at least 8,000 times in a quarter century of service at the cemetery. "It's a nice piece of music. It's like a song," he says. "Unlike a lot of bugle calls, you can inflect it, you can play music with it." Adds Master Sgt. John Abbracciamento, a Marine Corps bugler, "I don't want to be detached when I play during a funeral. I want to do something for that family. They'll never know who I am, but they'll never forget."

At 24 notes, "Taps" also has the virtue of brevity in graveside services that often conclude in ten minutes or less. As an Arlington guide for clergy notes, "Please remember that time is our enemy at ANC."

Space is also an enemy, or rather the lack of it. For more than a half century, Arlington's guardians have cautioned that the cemetery is running out of room. As author Philip Bigler noted in his comprehensive history, *In Honored Glory*, a surge in interments during World War II led to a warning in 1944 that grave space "will be exhausted in five to seven years . . . only 14,000 more persons can be buried in Arlington." Grave dimensions were reduced, from six by twelve feet to five by ten; tiered burials—with caskets stacked like bunk beds in the same hole—were adopted in the early 1960s, followed by the controversial new regulations that sharply curtailed eligibility. Parcels of land were appended over the years, notably 190 acres from the Fort Myer South Post. Still, at the current rate of interment, Arlington will be at capacity around 2060.

Few issues have greater urgency for John C. Metzler, Jr., Arlington's superintendent since 1991. A former Army helicopter crew chief in Vietnam, Metzler lives in the same gabled house behind the Custis-Lee mansion where he grew up: His father, who is buried in section 7A, was superintendent here from 1951 to 1972. Asked to pick his favorite section of the cemetery, Metzler replies, "I always walk around section 1

Small stones whisper words to the dead, and bear witness that the living still remember. At Arlington, mourners often meet strangers on similar pilgrimages. Here they can talk and share stories. And they see that in the end they are not alone.

WENDY GALIETTA

In section 60 the raw graves of the dead from Iraq and Afghanistan are appointed with amulets for the next world. One message on a smooth stone could crack the hardest heart: "I love you, Daddy. Happy birthday."

because that's where I live. I know virtually everybody in section 1. But section 2 has a wonderful view of Washington, D.C. I'll walk over there sometimes at night and just ponder for 20 minutes or half an hour."

Metzler's master plan, drafted in 1998, identified 14 parcels of land abutting the existing cemetery. Collectively those tracts, mostly owned by federal agencies, would provide another 125 acres; Metzler so far has acquired 3 of the 14. Topography is always an issue because steep slopes are the gravedigger's bane. "Eight hundred graves per acre is the optimum," Metzler says, "and if there are less than 600, then you're probably talking about too much slope to stabilize the gravedigging equipment."

Each opened grave yields roughly one and a half cubic yards of excess dirt, and that spoil is now used to build up the final few acres of a new swatch. Some 20,000 graves will occupy the sector, with a sweeping view of the Potomac, and niches for cremated remains will be built into the cemetery's perimeter wall. A long grassy stretch also remains unturned in section 60, sacred ground awaiting those whose fates will lead them here. Roughly one in every ten soldiers killed in Iraq is buried at Arlington, a higher percentage than from any previous American war.

THE SEASONS RISE, the seasons fall away. Arlington bustles year-round, but with a stately, measured grace. A squall line blows through, tossing the great trees. Rain pelts the graves and laves the headstones, each emblematic of who we were, where we've been, and what we have become. Then the afternoon skies fair and the final funeral procession of the day snakes through the great yard, bearing another old soldier to his rest, or perhaps a soldier no older than William Christman was.

Across the river, the federal city gleams in the dying sun. A tranquil silence descends, broken only by the distant rap of a drum. □

Where Heroes Rest Take a tour of the nation's cemetery with an interactive map; visit the memorial to the victims of 9/11 at **ngm.com/0706.**

VICTORS WINGED

PANAMA'S ADAPTABLE BATS

Equipped with echolocation and gaffing claws, the greater bulldog bat can detect the hair-thin fin of a fish breaking the water's surface, a useful skill in a forest full of competitors.

NOCTILIO LEPORINUS

ARTIBEUS LITURATUS. BATS ON PRECEDING PAGES AND ABOVE WERE PHOTOGRAPHED IN ENCLOSURES.

A great fruit-eating bat grabs a ripe fig. Such frugivores disperse seeds in their waste, helping reforest cleared areas and sowing commercially valuable fruits. Plants and bats have evolved traits that promote alliances: Some figs, for example, ripen en masse with a blast of perfume that attracts bats from a distance. Bats are apt to sow seeds more widely than would birds.

PHOTOGRAPHS BY CHRISTIAN ZIEGLER

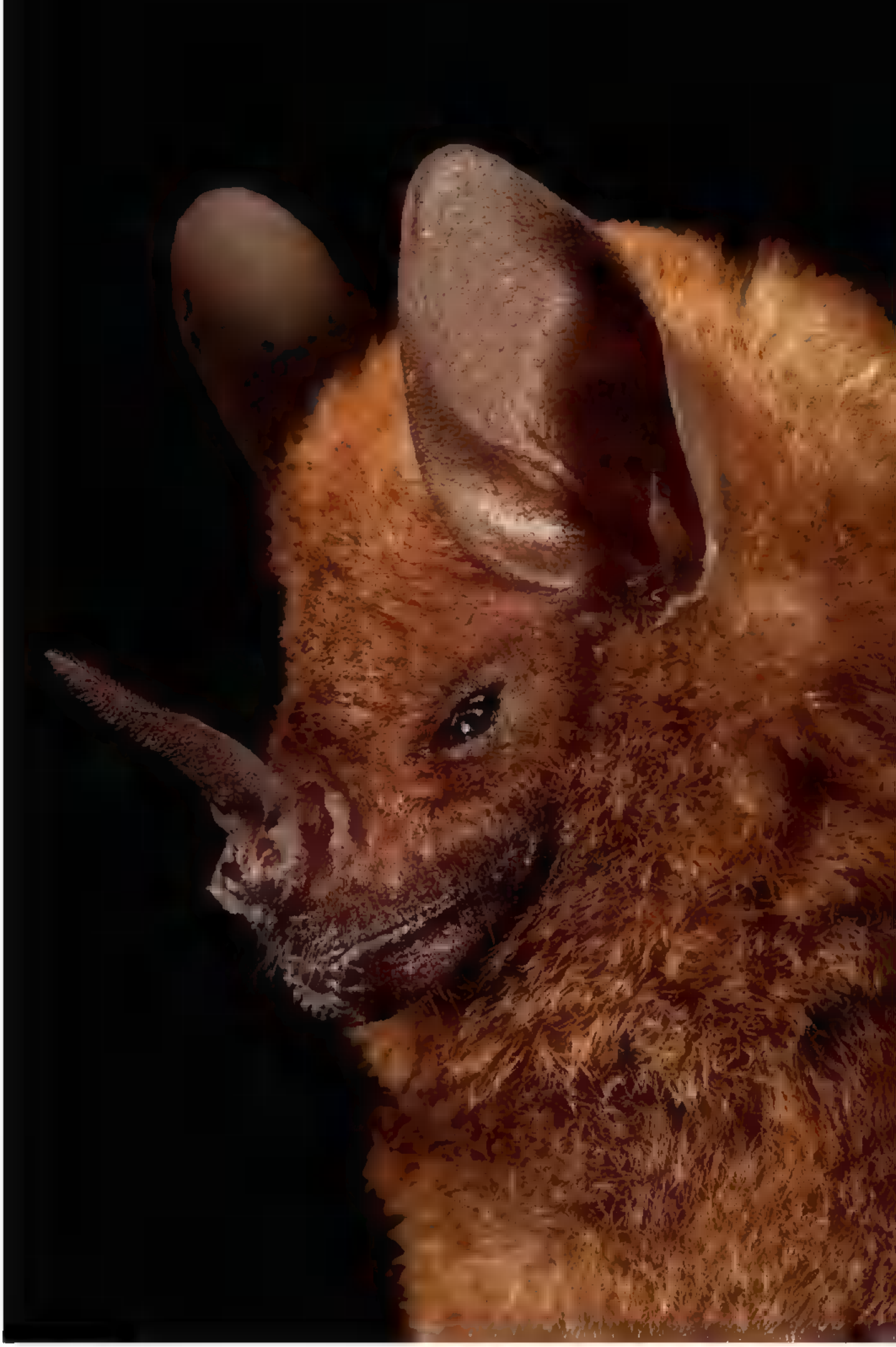
Sixty million years ago, on a planet crawling with mammals, one tree dweller rose above the crowd on paper-thin wings. So goes the story of ancestral bats, which, equipped with flight and a sixth sense called echolocation, mastered the night sky and flourished.

Having since exploded into more than 1,100 species worldwide, bats are still finding unique ways to evade the masses—and each other. Barro Colorado Island, a Key West–size knob of land in the Panama Canal, is a showplace of bat innovation. This patch of tropical forest is home to at least 74 distinct bat species; the entire United States has only 47, and all of Amazonia, with perhaps the highest bat diversity on Earth, logs about 160. With many thousands of individual bats sharing the island's 3,800 acres, it's a wonder their jagged wings don't entangle as they struggle to meet life's basic needs.

How do they all live in peace, skirting competition that would drive some to extinction? By finding their own niches in the forest's many layers. Where they roost, what they eat, when they feed, how they use their senses, where in the forest canopy they fly—each species has its own special how-to list inscribed on its genes, its own ways to exploit the island's endless summer. One bites through the lateral veins of a leaf to fold the sides down—creating a tentlike shelter for up to 15 of its kind to share. Another chews out a home for its harem in the heart of a termite nest, prompting the insects to move over and make room. (These bats choose only occupied nests as roosts; scientists are trying to find out why.) Some species chase down insects in the air, while others lick nectar and pollen from night-blooming flowers. Some use short pulses of sonar-like echolocation to find perched insects amid forest clutter; others send out longer calls to pinpoint airborne bugs, staying high above the tangled canopy.

Physical differences reflect these distinctive habits. Take greater bulldog bats, with their dagger-like claws and cheek pouches, in which they can carry fish they don't eat on the wing. Or herbivorous bats, some equipped with bristled tongues and grooved chins to pick up nectar and pollen as they nuzzle blossoms. Long, thin wings suit the bat that soars on high; broad, compact wings allow quick turns for the one dodging trees down low. Ample ears? Tiny eyes? Flesh-ripping canines? A nose flap? Each feature is a clue to how a species makes its living.

The tropical forest not only supports this immense diversity, it also depends on it. Bats spread seeds and pollen, keep a cap on herbivorous pests that might decimate forest flora, and themselves become meals for other forest animals—monkeys, owls, falcons, other bats, even large spiders. Such a healthy ecosystem can sustain quite a crowd, especially when each species knows its place. —JENNIFER S. HOLLAND, NG STAFF



CAROLLIA CASTANEA

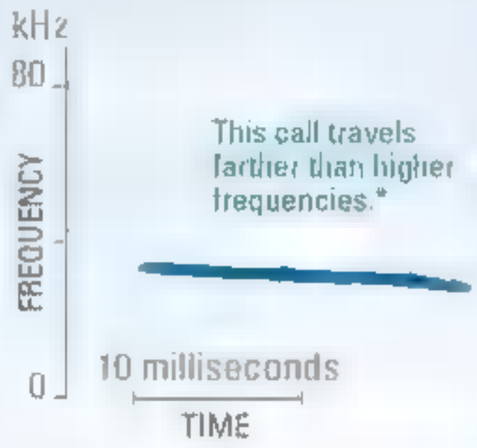
A keen sense of smell and a "nose leaf," which tilts to direct the animal's echolocation call, help the chestnut short-tailed bat pinpoint pepper plants in the forest understory. With claws that knife through water (opposite), the greater bulldog bat trawls for prey. Such feeding strategies minimize resource wars.

ECHO HUNTERS

The myriad bats on tiny Barro Colorado make the most of the islands diverse habitats with their specialized use of echolocation—bouncing high-frequency sound off obstacles and prey.

Open spaces

Bats hunting above the canopy rely heavily on echolocation.

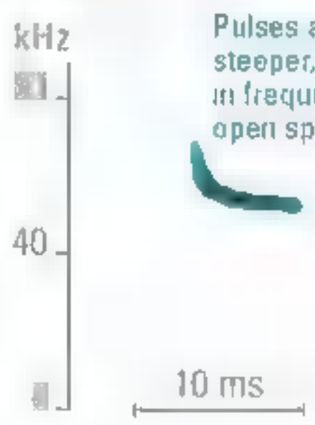


PALLAS' MASTIFF BAT

Flying at high speeds, it emits long calls that shorten as it nears insect prey.

Forest edges and gaps

Bats must discriminate between insect echoes and echoes from vegetation, ground, or water surfaces.

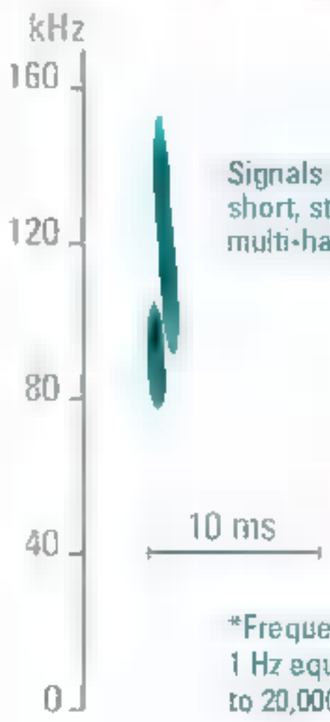


BLACK MYOTIS BAT

Foraging around trees, it can eat its weight in insects nightly.

Narrow spaces

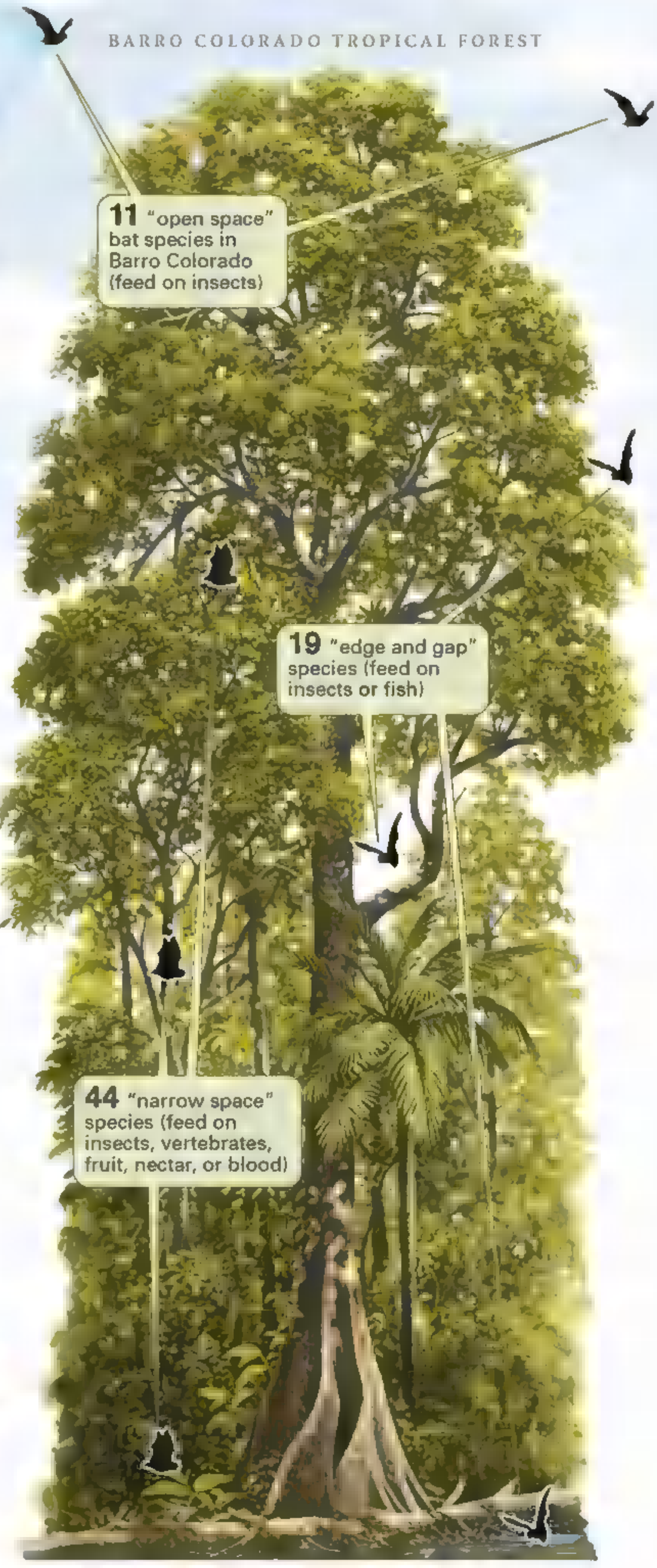
Echoes from potential food may be masked by clutter echoes. Bats also rely on smell, hearing, touch, and sight.



LONG-TONGUED BAT

It aims echolocation calls with its tiltable nose leaf. It also uses smell to find open flowers at night and laps nectar and pollen with its tongue.

*Frequency is how fast sound waves vibrate, measured in hertz: 1 Hz equals one vibration a second. Humans can hear from 20 Hz to 20,000 Hz (20 kHz). Anything higher is called ultrasound.



SOURCES: ELISABETH KALKO, SMITHSONIAN TROPICAL RESEARCH INSTITUTE; EGBERT GILES LEIGH, JR., *TROPICAL FOREST ECOLOGY*

RESEARCH BY BRENNA MALONEY; ART BY RAUL MARTÍN

Barro Colorado Island rises from Lake Gatún in the Panama Canal. Protected since the 1920s, its 3,800 acres of lowland tropical forest holds habitat rich in food and roosts—enough to support the island's 74 (and counting) bat species. Working with Elisabeth Kalko of the Smithsonian Tropical Research Institute, Sergio Estrada-Villegas (below) studies species that inhabit the canal's smaller islands. Says Kalko, "The bats here are so specialized, yet still highly adaptable if they find new resources. That's the key to their success."

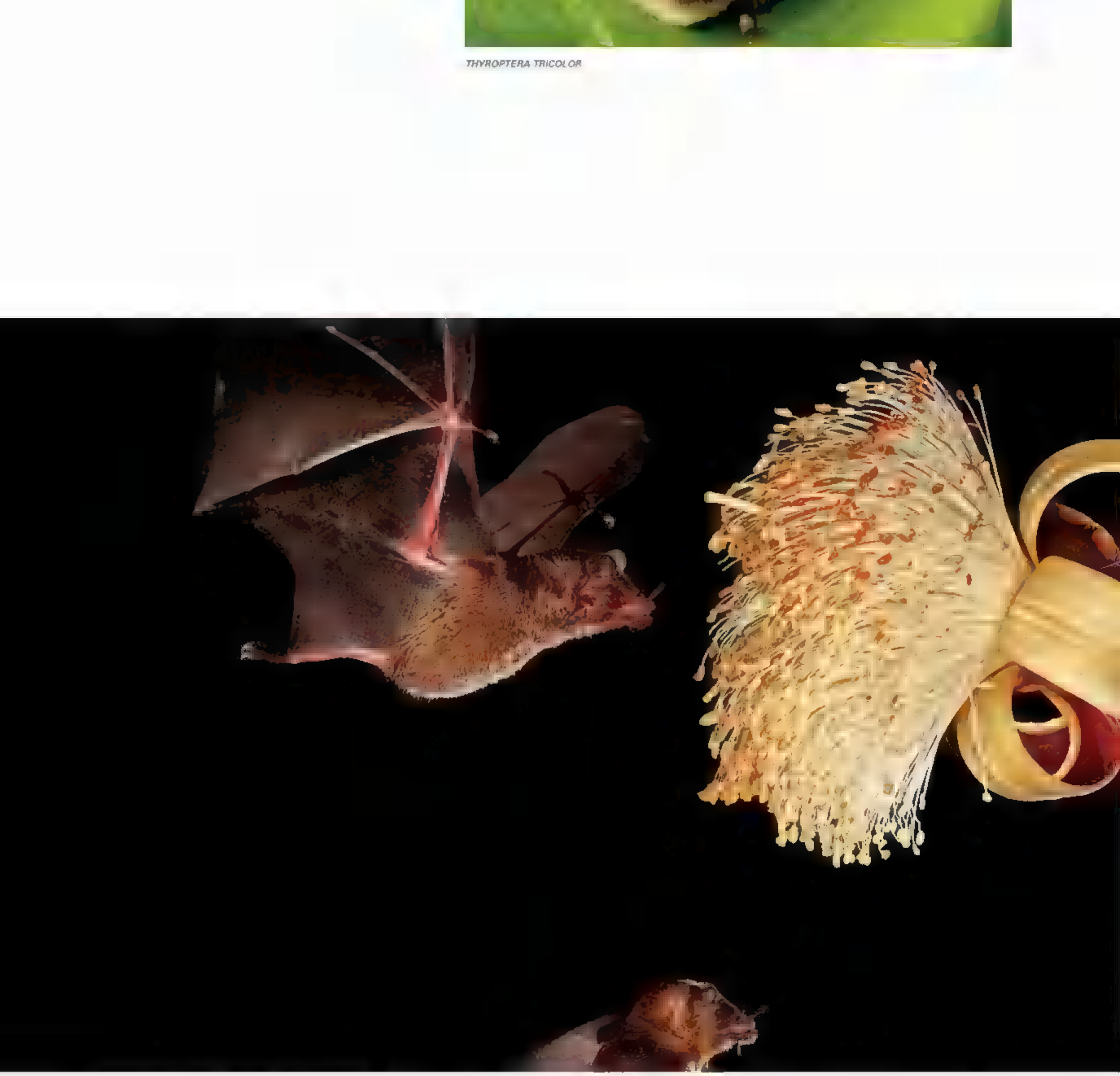
VAMPYRODES CARACCIOLI

TRACHOPS CIRRHOSUS; PHOTOGRAPHED IN AN ENCLOSURE

Barro Colorado's bats thrive by specializing. Spix's disk-winged bats (opposite, top) have suction cups at their thumbs and ankles that enable them to grip the inside of a smooth furled leaf and scuttle in and out of its protective confines. At mealtime the fringe-lipped bat (above) ignores blooms, instead listening for frog mating calls—even distinguishing the sound of poisonous species from edible ones. It swoops in to snatch one up with its well-developed canines and may down ten more before the night is out. (Some frogs' calls have changed in response to regular predation by bats.) Meanwhile, extravagant blossoms rich in nectar invite long-tongued bats to bury their faces in hundreds of flowers ■ night, pollinating one after another in the process.

Messy Moment Photographer Christian Ziegler didn't know which was worse: being showered with bat urine or sharing ■ tree trunk with cockroaches. Read more in Field Notes at **ngm.com/0706.**

THYROPTERA TRICOLOR



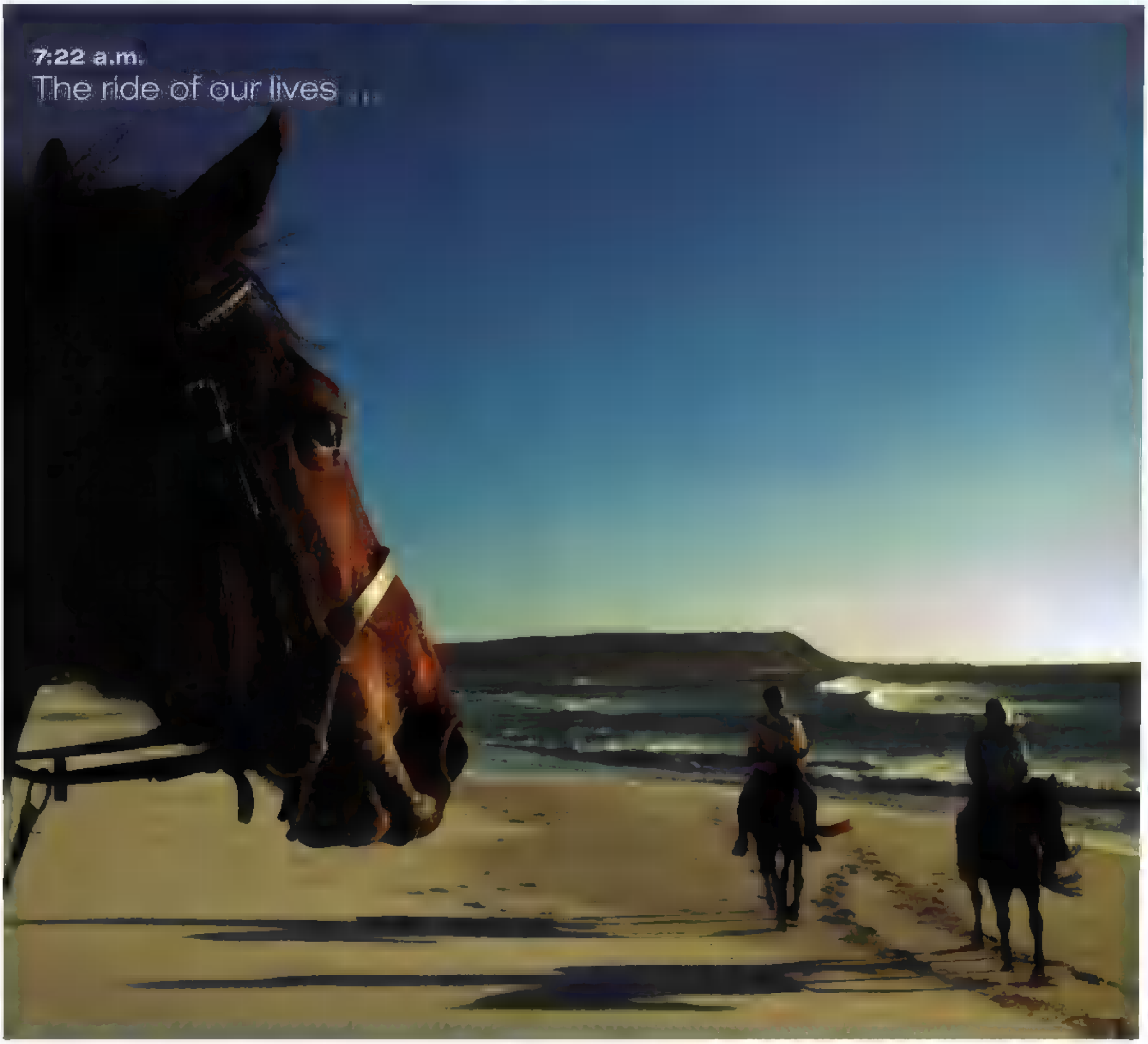
GLOSSOPHAGA SP.; PHOTOGRAPHED IN AN ENCLOSURE

LOPHOSTOMA SILVICOLUM

A chewed-out cavity in an arboreal termite nest houses *Lophostoma* bats, which may derive warmth from the active insect colony within. Scientists suspect chemical signals between bats and bugs could prompt the termites to wall themselves off from, rather than attack, their unwelcome guests.

Strobes capture a greater bulldog bat's success on Lake Gatún. The behavior likely originated when insect-eaters snagged fish by mistake. Trick became tradition, and another specialist took its place Panama's night skies.

NOCTILIO LEPORINUS



UNDER SOUTHERN AFRICAN SKIES . . .

South Africa - Cape Town We rose early, with the first traces of light just beginning to chase away the darkness. Driving away from the city, we followed the twisting highway toward Chapman's Peak, hugging the coastline between the majestic range of mountains and the deep blue of the ocean. Table Mountain, Lion's Head, the Twelve Apostles, and the Sentinal, peaks that tower in the imagination and define this stretch of coast. Finally we rounded the final curve and gazed down on the wild beauty of Noordhoek Beach, the waves breaking on the pristine white sand. It was a fantastic start to the day, and riding along the edge of this mighty continent was a privilege indeed.

Late afternoon saw us heading up to the world-renowned wine region, packed with famous vineyards. At Lourensford, Somerset West, we walked the beautiful grounds and chanced upon a lovely lake, the perfect spot for a picnic. As the sun set, we savoured the delicious vintage chardonnay and toasted another memorable day in South Africa.

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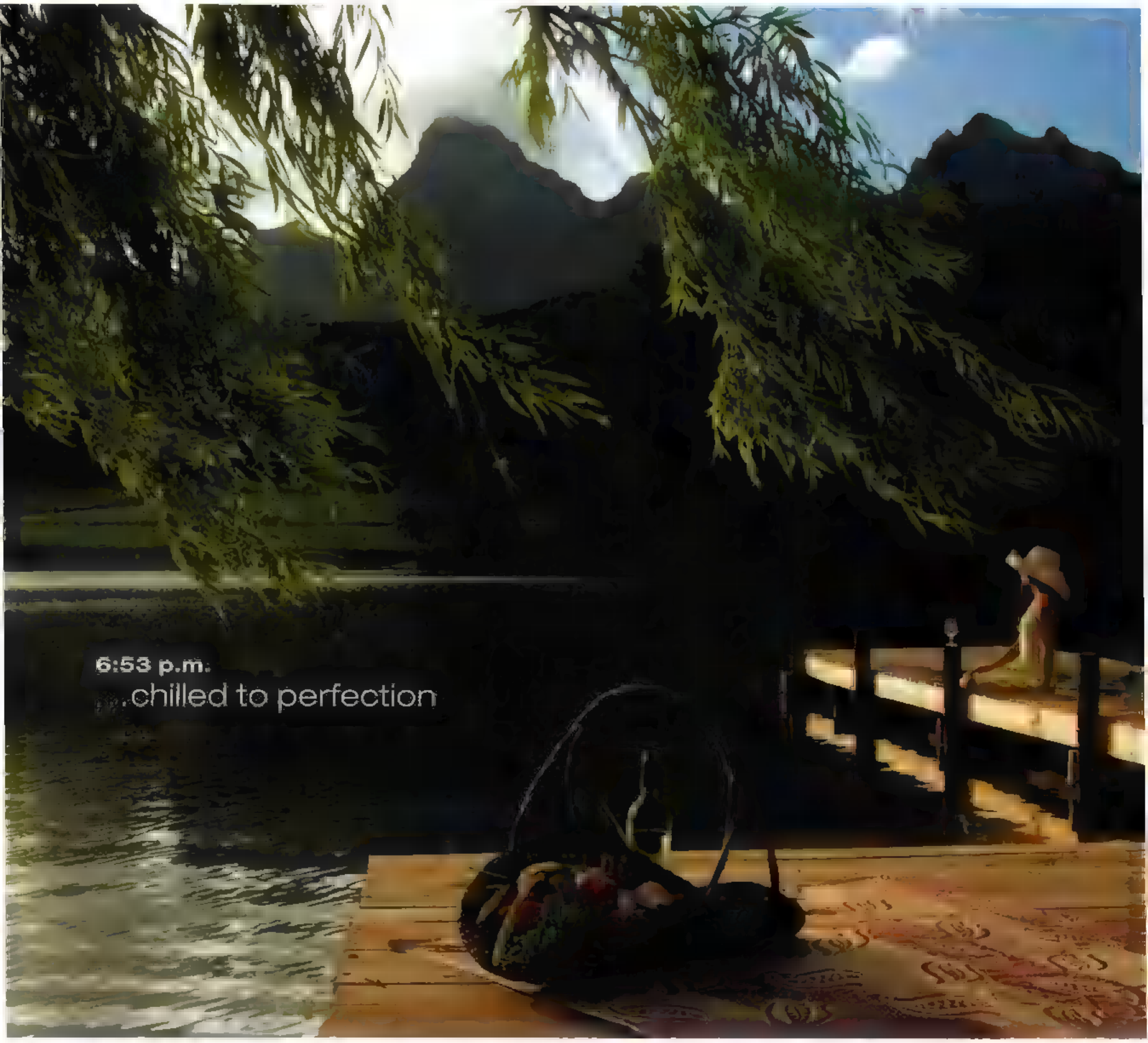

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THE AIRLINE NETWORK FOR EARTH.

A stray leaf sinks into Alaska's Mendenhall Glacier.

THE BIG THAW, PAGE 56

Figure Out Your Footprint

As you cool your home this summer, you might well be helping to warm up the world. Air-conditioning and other power-hungry appliances are major contributors to the average household's carbon footprint, a measure of personal impact on climate through the production of carbon dioxide and other greenhouse gases. Here are some ways to shrink your footprint's size:

■ **Online questionnaires** are a way to calculate your current energy use. The calculator below includes options for residents of the U.S. and Canada, as well as for other countries.

safeclimate.net/calculator

■ **This carbon equivalency calculator** translates units of greenhouse gases saved into easily understandable equivalents: gallons of gas saved, acres of forest preserved, and more.

usctcgateway.net/tool

■ **The Green Guide,** a National Geographic consumer publication and website, has many suggestions for following a low-carbon diet (see box at right). The actual amount of carbon dioxide a household releases depends on the fuel sources used by its energy provider. The average American produces more than 22 tons of carbon dioxide each year. For more information on carbon savings, including carbon calculators for each room in the house, see *The Green Guide's* Green Home section.

thegreenguide.com

AVERAGE ANNUAL HOUSEHOLD POUNDS OF CARBON DIOXIDE SAVED

1,000
If you recycle glass, plastic, and paper.

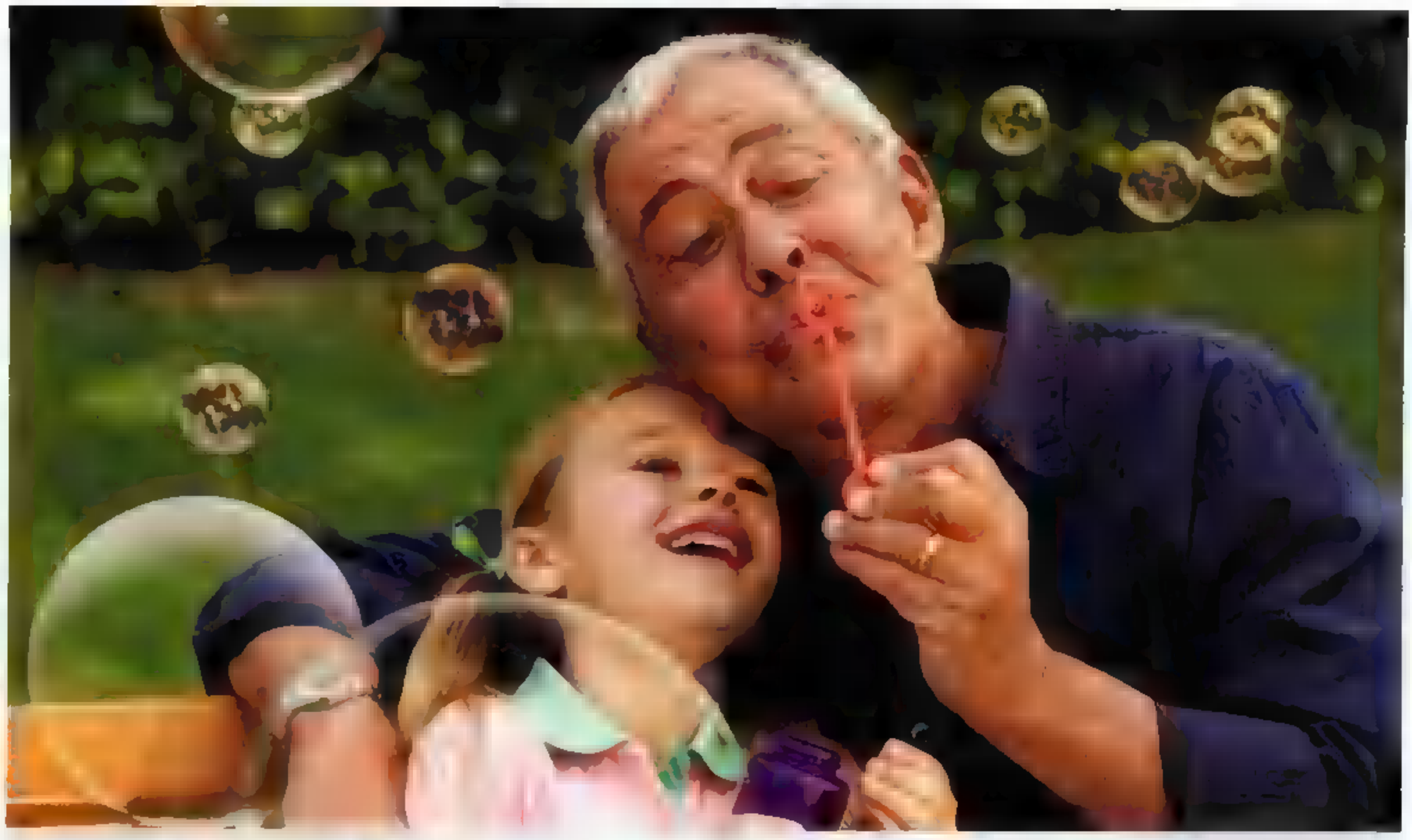
800
If you take the bus to work instead of driving.

720
If you line-dry half your laundry loads instead of using the dryer.

700
If you maintain ■ tight seal on your refrigerator door and keep the appliance's coils clean.

55
If you replace a 75-watt incandescent lightbulb with ■ 20-watt compact fluorescent bulb.

PHOTO: ALLISON TURNER



ADVAIR® significantly improves lung function to help you breathe better.*

If you have COPD associated with chronic bronchitis, ADVAIR 250/50 may help.

ADVAIR is different from other COPD medications. ADVAIR is the only product with an anti-inflammatory and a bronchodilator working together to improve lung function.

Get your first full prescription FREE†
Go to AdvairCOPD.com or call 1-800-987-4900.
Ask your doctor about ADVAIR today.

The way anti-inflammatories work in the treatment of COPD is not well defined.

Important Information: ADVAIR DISKUS 250/50 is approved for controlling symptoms and preventing wheezing in adults with COPD associated with chronic bronchitis. The benefit of using ADVAIR for longer than 6 months has not been evaluated. You should only take 1 inhalation of ADVAIR twice a day. Taking higher doses will not provide additional benefits but may increase your chance of certain side effects. Lower respiratory tract infections, including pneumonia, have been reported with ADVAIR. Patients at risk for developing bone loss (osteoporosis) and some eye problems (cataracts or glaucoma) should be aware that use of inhaled corticosteroids, including ADVAIR, may increase your risk. You should consider having regular eye exams. ADVAIR does not replace fast-acting inhalers for acute symptoms.

* Measured by a breathing test in people taking ADVAIR 250/50, compared with people taking either fluticasone propionate 250 mcg or salmeterol 50 mcg. Your results may vary.

GlaxoSmithKline

If you don't have prescription coverage, visit pparx.org, or call 1-888-4PPA-NOW (1-888-477-2669)

ADVAIR DISKUS 250/50
(fluticasone propionate 250 mcg and salmeterol 50 mcg inhalation powder)

If you smoke and want to quit, you can learn more at ...2quit.com

Subject to eligibility. Restrictions apply. Please see accompanying important information about ADVAIR DISKUS 250/50.

ADVAIR DISKUS 100/50, 250/50, 500/50

(fluticasone propionate 100, 250, 500 mcg and salmeterol 50 mcg inhalation powder)

What is the most important information I should know about ADVAIR DISKUS?
In patients with asthma, long-acting beta$_2$-agonist medicines such as salmeterol (one of the medications in ADVAIR®) may increase the chance of death from asthma problems. In a large asthma study, more patients who used salmeterol died from asthma problems compared with patients who did not use salmeterol. So ADVAIR is not for patients whose asthma is well controlled on another asthma controller medicine such as low- to medium-dose inhaled corticosteroids or only need a fast-acting inhaler once in a while. Talk with your doctor about this risk and the benefits of treating your asthma with ADVAIR.

ADVAIR should not be used to treat a severe attack of asthma or chronic obstructive pulmonary disease (COPD) requiring emergency medical treatment.

ADVAIR should not be used to relieve sudden symptoms or sudden breathing problems. Always have a fast-acting inhaler with you to treat sudden breathing difficulty. If you do not have a fast-acting inhaler, contact your doctor to have one prescribed for you.

What is ADVAIR DISKUS?
There are two medicines in ADVAIR: Fluticasone propionate, an inhaled anti-inflammatory belonging to a group of medicines commonly referred to as corticosteroids; and salmeterol, a long-acting, inhaled bronchodilator belonging to a group of medicines commonly referred to as beta$_2$-agonists. There are 3 strengths of ADVAIR: 100/50, 250/50, 500/50.

For Asthma
- ADVAIR is approved for the maintenance treatment of asthma in patients 4 years of age and older. ADVAIR should only be used if your doctor decides that another asthma controller medicine alone does not control your asthma or that you need 2 asthma controller medications.
- The strength of ADVAIR approved for patients ages 4 to 11 years who experience symptoms on an inhaled corticosteroid is ADVAIR DISKUS 100/50. All 3 strengths are approved for patients with asthma ages 12 years and older.

For COPD associated with chronic bronchitis
ADVAIR 250/50 is the only approved dose for the maintenance treatment of airflow obstruction in patients with COPD associated with chronic bronchitis. The benefit of using ADVAIR for longer than 6 months has not been evaluated. The way anti-inflammatories work in the treatment of COPD is not well defined.

Who should not take ADVAIR DISKUS?
You should not start ADVAIR if your asthma is becoming significantly or rapidly worse, which can be life threatening. Serious respiratory events, including death, have been reported in patients who started taking salmeterol in this situation, although it is not possible to tell whether salmeterol contributed to these events. This may also occur in patients with less severe asthma.

You should not take ADVAIR if you have had an allergic reaction to it or any of its components (salmeterol, fluticasone propionate, or lactose). Tell your doctor if you are allergic to ADVAIR, any other medications, or food products. If you experience an allergic reaction after taking ADVAIR, stop using ADVAIR immediately and contact your doctor. Allergic reactions are when you experience one or more of the following: choking; breathing problems; swelling of the face, mouth and/or tongue; rash; hives; itching; or welts on the skin.

Tell your doctor about the following:
- If you are using your fast-acting inhaler more often or using more doses than you normally do (e.g., 4 or more inhalations of your fast-acting inhaler for 2 or more days in a row or a whole canister of your fast-acting inhaler in 8 weeks' time), it could be a sign that your asthma is getting worse. If this occurs, tell your doctor immediately.
- If you have been using your fast-acting inhaler regularly (e.g., four times a day), your doctor may tell you to stop the regular use of these medications.
- If your peak flow meter results decrease. Your doctor will tell you the numbers that are right for you.
- If you have asthma and your symptoms do not improve after using ADVAIR regularly for 1 week.
- If you have been on an oral steroid, like prednisone, and are now using ADVAIR. You should be very careful as you may be less able to heal after surgery, infection, or serious injury. It takes a number of months for the body to recover its ability to make its own steroid hormones after use of oral steroids. Switching from an oral steroid may also unmask a condition previously suppressed by the oral steroid such as allergies, conjunctivitis, eczema, arthritis, and eosinophilic conditions. Symptoms of an eosinophilic condition can include rash, worsening breathing problems, heart complications, and/or feeling of "pins and needles" or numbness in the arms and legs. Talk to your doctor immediately if you experience any of these symptoms.
- Sometimes patients experience unexpected bronchospasm right after taking ADVAIR. This condition can be life threatening and if it occurs, you should immediately stop using ADVAIR and seek immediate medical attention.
- If you have any type of heart disease such as coronary artery disease, irregular heart beat or high blood pressure, ADVAIR should be used with caution. Be sure to talk with your doctor about your condition because salmeterol, one of the components of ADVAIR, may affect the heart by increasing heart rate and blood pressure. It may cause symptoms such as heart fluttering, chest pain, rapid heart rate, tremor, or nervousness.
- If you have seizures, overactive thyroid gland, liver problems, or are sensitive to certain medications for breathing.
- If your breathing problems get worse over time or if your fast-acting inhaler does not work as well for you while using ADVAIR. If your breathing problems worsen quickly, get emergency medical care.
- If you have been exposed to or currently have chickenpox or measles or if you have an immune system problem. Patients using medications that weaken the immune system are more likely to get infections than healthy individuals. ADVAIR contains a corticosteroid (fluticasone propionate) which may weaken the immune system. Infections like chickenpox and measles, for example, can be very serious or even fatal in susceptible patients using corticosteroids.

How should I take ADVAIR DISKUS?
ADVAIR should be used 1 inhalation, twice a day (morning and evening). ADVAIR should never be taken more than 1 inhalation twice a day. The full benefit of taking ADVAIR may take 1 week or longer.

If you miss a dose of ADVAIR, just skip that dose. Take your next dose at your usual time. Do not take two doses at one time.

Do not stop using ADVAIR unless told to do so by your doctor because your symptoms might get worse.

Do not change or stop any of your medicines used to control or treat your breathing problems. Your doctor will adjust your medicines as needed.

When using ADVAIR, remember:
- Never breathe into or take the DISKUS® apart.
- Always use the DISKUS in a level position.
- After each inhalation, rinse your mouth with water without swallowing.
- Never wash any part of the DISKUS. Always keep it in a dry place.
- Never take an extra dose, even if you feel you did not receive a dose.
- Discard 1 month after removal from the foil overwrap.
- Do not use ADVAIR with a spacer device.

Children should use ADVAIR with an adult's help as instructed by the child's doctor.

Can I take ADVAIR DISKUS with other medications?
Tell your doctor about all the medications you take, including prescription and nonprescription medications, vitamins, and herbal supplements.

If you are taking ADVAIR, you should not take SEREVENT® DISKUS or Foradil® Aerolizer® for any reason.

If you take ritonavir (an HIV medication), tell your doctor. Ritonavir may interact with ADVAIR and could cause serious side effects. The anti-HIV medicines Norvir® Soft Gelatin Capsules, Norvir Oral Solution, and Kaletra® contain ritonavir.

No formal drug interaction studies have been performed with ADVAIR.

In clinical studies, there were no differences in effects on the heart when ADVAIR was taken with varying amounts of albuterol. The effect of using ADVAIR in patients with asthma while taking more than 9 puffs a day of albuterol has not been studied.

ADVAIR should be used with extreme caution during and up to 2 weeks after treatment with monoamine oxidase (MAO) inhibitors or tricyclic antidepressants since these medications can cause ADVAIR to have an even greater effect on the circulatory system.

ADVAIR should be used with caution in people who are taking ketoconazole (an antifungus medication) or other drugs broken down by the body in a similar way. These medications can cause ADVAIR to have greater steroid side effects.

Generally, people with asthma should not take beta-blockers because they counteract the effects of beta$_2$-agonists and may also cause severe bronchospasm. However, in some cases, for instance, following a heart attack, selective beta-blockers may still be used if there is no acceptable alternative.

The ECG changes and/or low blood potassium that may occur with some diuretics may be made worse by ADVAIR, especially at higher-than-recommended doses. Caution should be used when these drugs are used together.

In clinical studies, there was no difference in side effects when ADVAIR was taken with methylxanthines (e.g., theophylline) or with FLONASE®.

What are other important safety considerations with ADVAIR DISKUS?
Osteoporosis: Long-term use of inhaled corticosteroids may result in bone loss (osteoporosis). Patients who are at risk for increased bone loss (tobacco use, advanced age, inactive lifestyle, poor nutrition, family history of osteoporosis, or long-term use of drugs such as corticosteroids) may have a greater risk with ADVAIR. If you have risk factors for bone loss, you should talk to your doctor about ways to reduce your risk and whether you should have your bone density evaluated.

Glaucoma and cataracts: Glaucoma, increased pressure in the eyes, and cataracts have been reported with the use of inhaled steroids, including fluticasone propionate, a medicine contained in ADVAIR. Regular eye examinations should be considered if you are taking ADVAIR.

Lower respiratory tract infection: Lower respiratory tract infections, including pneumonia, have been reported with the use of inhaled corticosteroids, including ADVAIR.

Blood sugar: Salmeterol may affect blood sugar and/or cause low blood potassium in some patients, which could lead to a side effect like an irregular heart rate. Significant changes in blood sugar and blood potassium were seen infrequently in clinical studies with ADVAIR.

Growth: Inhaled steroids may cause a reduction in growth velocity in children and adolescents.

Steroids: Taking steroids can affect your body's ability to make its own steroid hormones, which are needed during infections and times of severe stress to your body, such as an operation. These effects can sometimes be seen with inhaled steroids (but it is more common with oral steroids), especially when taken at higher-than-recommended doses over a long period of time. In some cases, these effects may be severe. Inhaled steroids often help control symptoms with less side effects than oral steroids.

Yeast infections: Patients taking ADVAIR may develop yeast infections of the mouth and/or throat ("thrush") that should be treated by their doctor.

Tuberculosis or other untreated infections: ADVAIR should be used with caution, if at all, in patients with tuberculosis, herpes infections of the eye, or other untreated infections.

What are the other possible side effects of ADVAIR DISKUS?
ADVAIR may produce side effects in some patients. In clinical studies, the most common side effects with ADVAIR included:

- Respiratory infections
- Throat irritation
- Hoarseness
- Sinus infection
- Yeast infection of the mouth
- Bronchitis
- Cough
- Headaches
- Nausea and vomiting
- Diarrhea
- Musculoskeletal pain
- Dizziness
- Fever
- Ear, nose, and throat infections
- Nosebleed

Tell your doctor about any side effect that bothers you or that does not go away. These are not all the side effects with ADVAIR. Ask your doctor or pharmacist for more information.

What if I am pregnant, planning to become pregnant, or nursing?
Talk to your doctor about the benefits and risks of using ADVAIR during pregnancy, labor, or if you are nursing. There have been no studies of ADVAIR used during pregnancy, labor, or in nursing women. Salmeterol is known to interfere with labor contractions. It is not known whether ADVAIR is excreted in breast milk, but other corticosteroids have been detected in human breast milk. Fluticasone propionate, like other corticosteroids, has been associated with birth defects in animals (e.g., cleft palate and fetal death). Salmeterol showed no effect on fertility in rats at 180 times the maximum recommended daily dose.

What other important tests were conducted with ADVAIR?
There is no evidence of enhanced toxicity with ADVAIR compared with the components administered separately. In animal studies with doses much higher than those used in humans, salmeterol was associated with uterine tumors. Your healthcare professional can tell you more about how drugs are tested on animals and what the results of these tests may mean to your safety.

For more information on ADVAIR DISKUS
This page is only a brief summary of important information about ADVAIR DISKUS. For more information, talk to your doctor. You can also visit www.ADVAIR.com or call 1-888-825-5249. Patients receiving ADVAIR DISKUS should read the medication guide provided by the pharmacist with the prescription.

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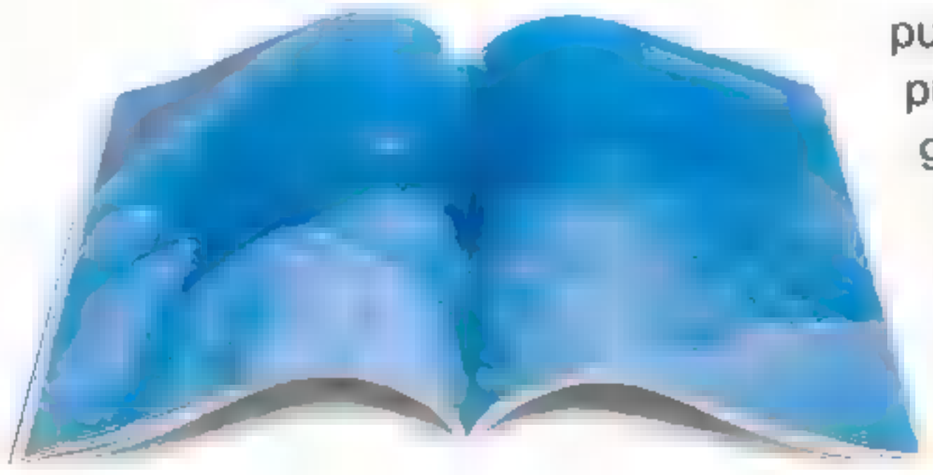
Archival prints of this Paul Nicklen photo—and others—are available at *PrintsNGS.com*.



BEHIND THE SCENES

The World on Your Wall

Among National Geographic Society staffers, a longtime favorite perk is having photos from our publications printed and framed for their offices. A walk through the halls is practically a gallery tour of iconic images by the world's best photographers. Now for the first time, that same privilege is available to the public through National Geographic's website. Check out photos from this month's issue (left) or from a constantly growing archive of more than 25,000 images, and choose from a variety of picture sizes and frame styles. The high-quality prints are made using Fujicolor Crystal Archive professional paper, designed to last. Prices start at $19.95 for an unframed ten-inch-wide print. Start your collection by going to *PrintsNGS.com*.

PHOTO: REBECCA HALE, NGS STAFF

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Rick Atkinson found a strong sense of mission at Arlington Cemetery.

ON ASSIGNMENT

Fields of Heroes

Section 60 of Arlington National Cemetery, where many of those killed in the current wars in Iraq and Afghanistan are buried, "is the saddest acre in America," says author Rick Atkinson. "I see the talismans and love tokens. It breaks my heart." He met a mother reading the children's book *Corduroy* to her son, who was killed in Iraq in 2005. "She drives down every few weeks to read to him. Then she puts an iPod down and plays him his songs." The cemetery is a place of grief, love, and honor, Atkinson says. "It's part of the warp and woof of our national story."

June Contributors

LIFE AT THE EDGE, page 32

Paul Nicklen contributes regularly to NATIONAL GEOGRAPHIC. His leopard seals story, which ran in the November 2006 issue, won a first prize in this year's World Press Photo contest.

THE BIG THAW, page 56

Tim Appenzeller is the GEOGRAPHIC's assistant executive editor. He writes often about global climate change for the magazine.

James Balog has been photographing, adventuring in, and studying the science of mountains and ice for 35 years. He is a *National Geographic Adventure* contributing editor.

A PASSION FOR ORDER, page 72

David Quammen was named a contributing writer for the magazine last year. He won a National Magazine Award—his third—for his November 2004 GEOGRAPHIC essay, "Was Darwin Wrong?" Quammen's most recent book is *The Reluctant Mr. Darwin*.

Helene Schmitz's photos of flowers for this story also appear in her latest book, *A Passion for Systems: Linnaeus and the Dream of Order in Nature*.

CHINA'S INSTANT CITIES, page 88

Peter Hessler, who lived in China for a decade, is working on his final book in a trilogy that includes *River Town* and *Oracle Bones*.

Mark Leong has been photographing China since 1989 and keeps finding boomtowns that even most Chinese have never even heard of. Some of his earlier work appears in the book *China Obscura*.

OUR NATION'S CEMETERY, page 118

Rick Atkinson is a reporter and editor at the *Washington Post*. His book *An Army at Dawn* won the 2003 Pulitzer Prize for history.

WINGED VICTORS, page 138

Jennifer S. Holland, ■ senior writer, helped untangle bats from nets while on assignment and discovered that bat fur is as soft as ■ kitten's.

Christian Ziegler specializes in natural history and science stories, often with tropical forest settings. The ecologist photographed tree frogs for the November 2006 issue.

Tales From the Field Learn more about our contributors in Features at **ngm.com/0706.**

PHOTO: NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN

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INSIDE GEOGRAPHIC

Taboo People have been decorating and altering their bodies for thousands of years. As much as aesthetics, the marks also reveal other cultural and personal values. In its fourth season, *Taboo* explores modern examples of ancient practices across the globe. Among the Hamar of Ethiopia's Omo Valley, the sisters of a boy going through a coming-of-age ceremony (above) will show family loyalty by submitting to whippings that can permanently scar their backs. Other episodes feature Burmese women's neck rings and the tattoos of Japan's criminal underworld.

NG Books

From Eden to Exile When Joshua fought the Battle of Jericho, did the walls really come tumbling down? Archaeologists and ancient historians have long sought evidence of those walls, of Noah's ark, and other stories from the Hebrew Bible. In *From Eden to Exile,* biblical archaeologist Eric Cline explores seven mysteries, reconciling Scripture with scientific and historical evidence ($26).

The 100 Best Vacations to Enrich Your Life Today, a vacation can mean learning how to weave a Navajo rug in New Mexico, making a film in New York City, or helping communities devastated by hurricanes. Packed with detailed information, this book is an invaluable resource for turning time off into time well spent ($19.95).

Connecting Over Climate

Adapt, flee . . . or die. That's how humans have responded to climate change over the eons. Nowadays, they also form partnerships. In a yearlong project, National Geographic and National Public Radio will explore *Climate Connections* on the air, on TV, in NATIONAL GEOGRAPHIC magazine, and online *(ngm.com/climateconnections* and *npr.org/climateconnections)* to see how climate shapes us and how we may be shaping climate.

PHOTO: REMI BENALI, CORBIS

A NATIONAL GEOGRAPHIC CHANNEL HD TELEVISION EVENT

INSIDE THE GREEN BERETS

It took over a year to secure access into this Green Beret unit in Afghanistan...
It only took four days for a Taliban attack to show us the true cost of war.

SUNDAY JUNE 3 9P et/pt

NATIONAL GEOGRAPHIC CHANNEL

FLASHBACK

Big Chill A colossus of ice and snow covered Niagara Falls on January 23, 1920, straddling the U.S. and Canadian shores and muffling the roar of water that rushed beneath. Published in the April 1922 GEOGRAPHIC, the text with this photo complained that water diversion to hydroelectric plants wounded Niagara's majesty. Today, successor plants produce 8,265,000 kilowatts of clean electricity. Global warming hasn't yet relegated Niagara's ice bridges to history. Winters have grown slightly warmer, but an ice bridge is expected to form every year for at least the next half century. *—Siobhan Roth*

Flashback Archive Find all the photos plus e-greetings at **ngm.com/0706.**

PHOTO: INTERNATIONAL FILM SERVICE

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Recycling that's easy to wrap around.

Wrapping yourself around a plan that recycles your used rechargeable batteries is easy. Check the batteries in your cordless and cellular phones, camcorders, cordless power tools, laptop computers, digital cameras, and two-way radios. If they no longer hold a charge, recycle them by visiting one of many collection sites nationwide, including those retailers listed below. For a complete list of rechargeable battery drop-off locations, visit **www.call2recycle.org** or call toll free **877-2-RECYCLE**.

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The #1 killer of teenagers *doesn't have a trigger.*

IT HAS A STEERING WHEEL.

Motor vehicle crashes are the #1 cause of death for teens in America. They take nearly 6,000 young lives and injure another 300,000 teens every year. Those numbers remain unacceptably high, despite safer cars, better roads and decades of safe-driving programs. We think it's time for a change.

So The Allstate Foundation has developed a new, nationwide program: "Keep the Drive." It mobilizes *teens* to become safe-driving activists by involving them in designing a new safe-driving program. And it uses the power of peer influence to help teens think and act smarter every time they get into a car — as a driver or a passenger.

Peers are some of the most important influences in getting teens to drive more safely. "Keep the Drive" can help them realize that **smart driving is the key to keeping their licenses, their cars, their friends and their futures.**

To learn more about this issue and what you can do to help, go to ProtectTeenDrivers.com. If you're a parent, you'll also find a link to the **Allstate Parent-Teen Driving Agreement.** Use it to help you and your teen set driving limits and make smarter decisions on the road.

It's time to make the world a better place to drive.
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